TEMS™ CellPlanner

WiMAX User's Guide

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EN/LZT 108 9839 R4A

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Preface

Document Conventions

This document uses the following conventions:

Bold type	Window names, button names, and keyboard keys are displayed as bold text. Example: Click **Edit.**
Menu↗Selection	Navigation in menu paths are displayed as bold text with arrows between menu levels.
`Typewriter type`	File names and literal input and output. Example: `sites.xml`
Italic type	Book titles and definitions are displayed in italic. Examples: *carrier mapping, Technical Reference Manual*
Left-click Right-click	All instructions including mouse clicks assume a mouse configured with the left mouse button as primary button.

Navigation

Use the ALT ← and ALT → buttons to navigate between link jumps in the Manuals.

Assumed Knowledge

This documentation presumes that you have good knowledge about radio network planning principles and the radio technology to plan.

Disclaimer

The parameter values in this manual are just examples to help you getting started quickly, and do not constitute any performance guarantees for the planned equipment of your final network planning.

Proper parameter values depend on the equipment version, the operator's business plan, and the operator's network deployment strategy. Recommended parameter values should be provided by the operator, the equipment vendor or your service delivery organization.

Manuals

The following PDF manuals are delivered with the TEMS CellPlanner software:

Installation Guide

EN/LZT 108 9831 R4A

Describes system requirements, how to install and configure TEMS CellPlanner components and manage licenses, and provides an overview of all TEMS CellPlanner components. The procedures must be performed by a user with administrator privileges on the local computer. Some procedures require that you are an authorized TEMS CellPlanner administrator.

Common Features User's Guide

EN/LZT 108 9832 R4A

Includes Glossary of terms used in TEMS CellPlanner, concepts about licenses, and how use projects, explorer objects used by more than one radio technology, how to add sites and use site tools, filters, plots, neighbors, AMI, tuning propagation models, ASMT (Automatic Sector Model Tuning), puncturing, export and import data, and work with projects on server. Here TEMS CellPlanner administrators find how to administer users, groups and projects on servers shared by multiple users.

Common Features Technical Reference Manual

EN/LZT 108 9833 R4A

Describes radio technology independent algorithms, parameters and file formats.

GeoData User's Guide

EN/LZT 108 9834 R4A

Describes geodata concepts, supported geodata formats, conversion between different map formats, how to use map data tools in TEMS CellPlanner. The chapters about providing and importing map data are intended for administrators of map data. Other chapters are intended for users of map data.

Map Import Wizard User's Guide

EN/LZT 108 9943 R2A

Describes how to import map data using a generic wizard similar to the one provided with TEMS LinkPlanner. The intended reader is administrator of map data.

LTE User's Guide

EN/LZT 108 9944 R3A

Describes how to use LTE functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

LTE Technical Reference Manual

EN/LZT 138 0235 R2A

Describes LTE network planning principles, analysis details for advanced users, and cell ID planning principles.

WCDMA User's Guide

EN/LZT 108 9837 R4A

How to use WCDMA functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

WCDMA Technical Reference Manual

EN/LZT 108 9838 R4A

Describes concepts and overviews of WCDMA algorithms, and HSPA and MBMS in TEMS CellPlanner.

GSM User's Guide

EN/LZT 108 9835 R4A

Describes how to use the GSM functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

GSM Technical Reference Manual

EN/LZT 108 9836 R4A

Describes overlaid/underlaid cell structures, reuse patterns, manual frequency planning, automatic frequency planning (AFP), automatic hopping frequency set (HFS) planning, optimization of BSIC, HSN and MAIO, fractional load planning, and effective subscriber modeling. Also describes the GSM algorithms and file formats used in TEMS CellPlanner.

WiMAX User's Guide

EN/LZT 108 9839 R4A

Describes how to use the WiMAX functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

1
Overview of TEMS CellPlanner

This chapter provides an overview of the TEMS CellPlanner product.

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About TEMS CellPlanner

TEMS™ CellPlanner is a graphical PC-based application for designing, implementing, and optimizing mobile radio networks. It assists you in performing complex tasks, including network dimensioning, traffic planning, site configuration, frequency planning, and network optimization.

Installation

The Installation Guide describes how to install software and licenses.

Product Packaging

The product package includes the software components listed below.

What is actually installed depends on your selection in the installation wizard.

Product Components	Selecting this component installs...
• TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	• Radio Technology Features • Planning Features • Manuals • Map tools, geodata conversion software, demo maps, filters, scripts • Citrix software - relevant only if you are going to offer this TEMS CellPlanner installation as a Citrix service
• Enterprise Server	Enterprise Server software plus the User Administration software
• Zero Admin Server	Zero Admin Server software plus the User Administration software
• User Administration	User Administration software only
• License Server	License Server software only

Some of the components are licensed, see Licensed Components on page 1-3.

The Installation Guide provides an overview of each component and how the components relate to each other.

Licenses

The Installation Guide describes how to install licenses.
The Common Features User's Guide describes how to activate licensed features.

Licensed Components

Three of the Product Components are licensed:

TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	To start TEMS CellPlanner you need a license for at least one of the Radio Technology Features. Additional licenses are required for each of the Radio Technology Features and Planning Features to use.
Enterprise Server	License required to start the server
Zero Admin Server	License required to start the server

Radio Technology Features

Each of the radio technology software modules listed below require an installed and activated license. How to use the radio technology software is described in adherent user guides and technical reference manuals.

- GSM
- WCDMA
- WCDMA,HSPA
- WiMAX
- LTE

Planning Features

Additional planning features can be used together with the radio technology software. These additional software modules require a license for the feature itself and a license for the adherent radio technology:

• Automatic Cell Planning	Requires WCDMA or WCDMA,HSPA license
• Automatic Frequency Planning	Requires GSM license. This license is required also for automatic HFS planning.
• Automatic Measurement Integration and ASMT	Requires license for at least one of the Radio Technology Features ASMT = Automatic Sector Model Tuning.

Support and FAQ

For support and FAQ about TEMS CellPlanner, use the TEMS support web site:

www.ascom.com/networktesting

To provide TEMS support with information when reporting a problem, follow the instructions in chapter *Support Information* in the Installation Guide.

2
WiMAX in TEMS CellPlanner

This chapter provides an overview of the WiMAX capabilities and analysis functions of TEMS CellPlanner.

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About WiMAX in TEMS CellPlanner

The WiMAX module in TEMS CellPlanner allows you to build a WiMAX network plan based on geographical data, analyze the network plan with a variety of propagation models, present analysis results in plots and reports, and export/import WiMAX data to/from Excel or text files.

WiMAX License

To get access to the WiMAX module in TEMS CellPlanner you need to acquire a WiMAX license and activate it.

For information on how to install a license, see *Installing Client Software* in the *TEMS CellPlanner Installation Guide*.

For information on how to activate licenses, see *Licenses* in *TEMS CellPlanner Common Features User's Guide*.

WiMAX Standards

TEMS CellPlanner provides analysis of network and terminal equipment compliant with the following WiMAX standards:

- IEEE 802.16d (2004)
- IEEE 802.16e (2005)

WiMAX Capabilities

TEMS CellPlanner supports the following WiMAX capabilities:

- PUSC and FUSC
- FDD (full or half) and S-TDD

WiMAX Analysis Functions

TEMS CellPlanner produces the following WiMAX analysis results:

- Best server coverage plots
- Downlink interference plots considering PUSC and FUSC
- Fixed subscriber report

- Traffic performance plots and report
- Intra-technology (WiMAX to WiMAX), intra-frequency neighbor lists

WiMAX Import and Export Data

TEMS CellPlanner supports import and export of the following WiMAX data:

- Fixed subscribers
- Intra-technology cell neighbor lists

3
WiMAX Introduction

This chapter provides an overview of WiMAX fundamentals.

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Scalable OFDMA (SOFDMA) 3-8

WiMAX Overview

WiMAX (Worldwide Interoperability for Microwave Access) can replace the telephone company's copper wire networks, the cables TV's coaxial cable infrastructure while offering ISP (Internet Service Provider) services.

The technology is based on the IEEE 802.16 standard also known as BWA (Broadband Wireless Access), there is the fixed WiMAX and mobile WiMAX.

- 802.16-2004 or 802.16d known as fixed WiMAX
- 802.16-2005 or 802.16e known as mobile WiMAX

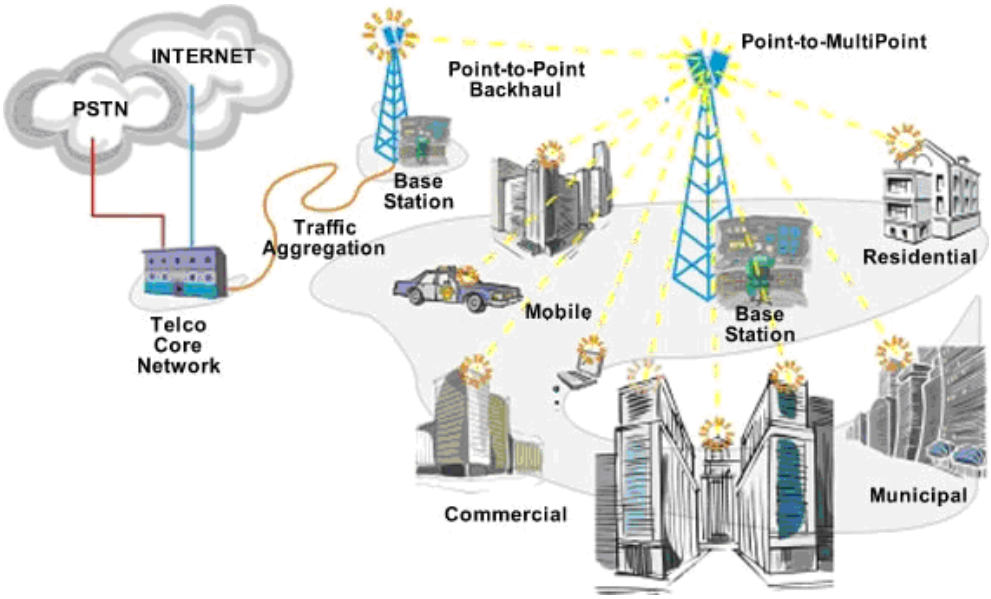


Figure 3–1 General WiMAX topology

WiMAX offers point-to-point and point-to-multipoint solutions [1]:

- Point-to-point (P2P) is used where there are two point of interest, the sender and the receiver, i.e. a business office. This is also a scenario for backhaul, where the throughput will be higher than that of point-to-multipoint products.
- Point-to-multipoint (PMP) is a synonymous of distribution, i.e. one base station can provide services for many subscribers.

The core of WiMAX is the radio, it means, the radio contains both a transmitter and a receiver. It generates oscillations at a frequency known as the carrier frequency (normally between 2 and 11GHz).

The architecture of WiMAX is radios and antennas. Most WiMAX products offer a base station radio and antennas separately.

Figure 3–2 illustrates the main types of antennas used in WiMAX architecture.

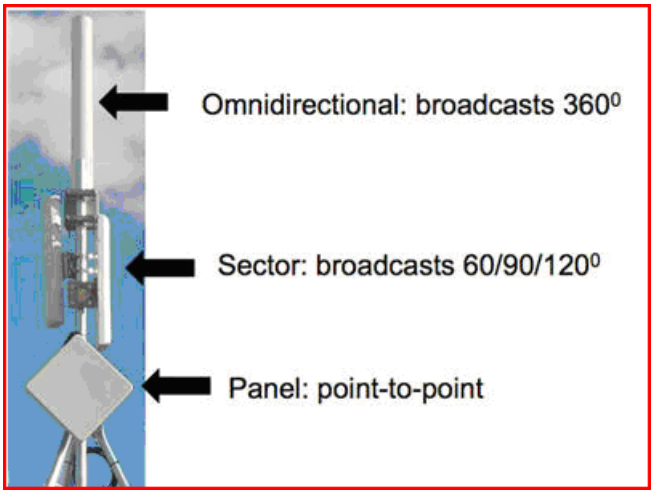


Figure 3–2 Types of antennas

The cable between the radio and the antennas are installed as small as possible in order to avoid loss of signal.

Omni directional antennas are used for PMP configurations and situations where there are a lot of subscribers located close to the base station, e.g. WiFi hotspot, the subscribers are concentrated in a small area.

A sector antenna offers greater range and throughput with less energy. It is usual to cover 360° service area with sector antennas, which are more focused.

There are two types of receiver antenna, outdoor and indoor, both called CPE (Customer Premise Equipment).

- Outdoor CPE offer better performance than indoor CPE, because there is no walls of concrete or brick blocking the signal. It maximizes the reception via a line of sight connection to the base station.
- Indoor CPE is installed by subscriber, can be sold online.

Before the equipment installation, there must be a site survey in order to have the necessities for a successful wireless operation.

The link budget [1] is the equation of the power of a signal transmitted minus losses between the transmitter and receiver, such as rain, interference from other broadcasters, vegetation, antenna gain, etc.

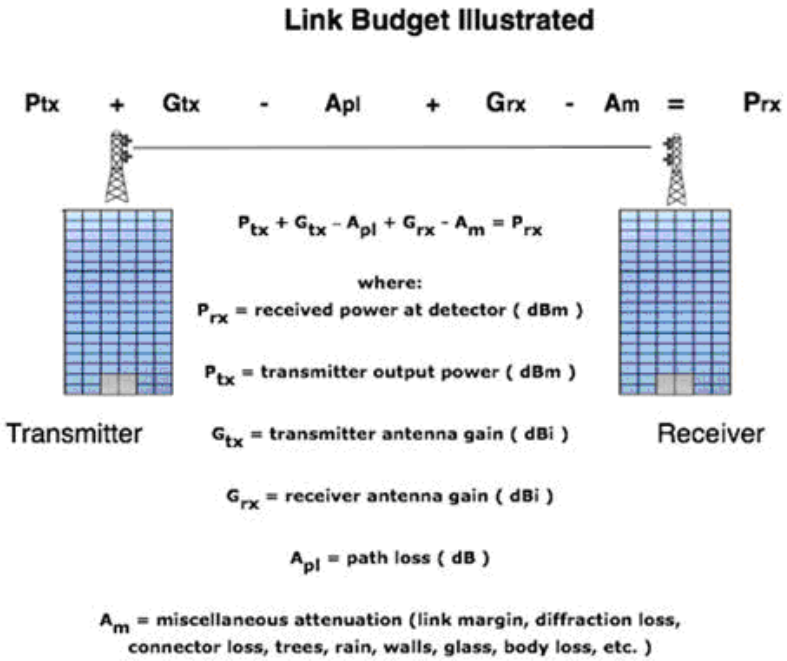

Link Budget Illustrated
Ptx + Gtx - Apl + Grx - Am = Prx
Ptx + Gtx - Apl + Grx - Am = Prx
where:
Prx = received power at detector (dBm)
Ptx = transmitter output power (dBm)
Transmitter
Gtx = transmitter antenna gain (dBi)
Receiver
Grx = receiver antenna gain (dBi)
Apl = path loss (dB)
Am = miscellaneous attenuation (link margin, diffraction loss, connector loss, trees, rain, walls, glass, body loss, etc.)

Figure 3–3 Illustrated Link Budget

Part of the site survey process is to determine a viable frequency plan.

Duplexing Scheme: TDD or FDD

Duplexing refers to the way downlink and uplink data is arranged in a two-way wireless transmission [2].

FDD (Frequency Division Duplex) requires two distinct channels for transmitting downlink sub-frame and uplink sub-frame at the same time slot. FDD is suitable for bi-directional voice since it occupies a symmetric downlink and uplink channel pair. WiMAX supports full-duplex FDD and half-duplex FDD.

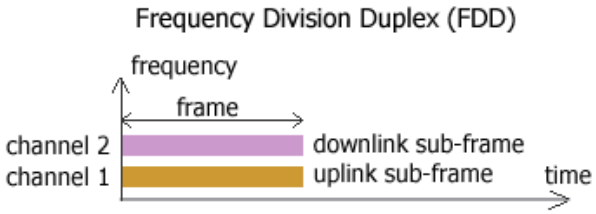
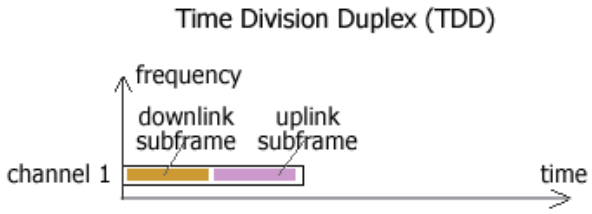


Figure 3–4 Frequency Division Duplex (FDD) – full duplex mode

FDD is inefficient for handling asymmetric data services since data traffic may only occupy a small portion of a channel bandwidth at any given time. TDD (Time Division Duplex) requires only one channel for transmitting downlink and uplink sub-frames at two different time slots. TDD therefore has higher spectral efficiency than FDD. TDD can flexibly handle both symmetric and asymmetric broadband



traffic.

Figure 3–5 Time Division Duplex (TDD)

TDD uses half of FDD spectrum hence saving the bandwidth and the system is less complex.

FDM, OFDM, OFDMA, SOFDMA

Frequency Division Multiplexing (FDM)

WiMAX air interface is based on OFDM/OFDMA physical layer (PHY). However, OFDM, OFDMA and SOFDMA are based on FDM system [2] that is described in Figure 3–6.

Figure 3–6 Frequency Division Multiplexing (FDM)

In FDM system, signals from multiple transmitters are transmitted simultaneously (at the same time slot) over multiple frequencies. Each frequency range (sub-carrier) is modulated separately by different data stream and spacing (guard band) is placed between sub-carriers to avoid overlap.

Orthogonal Frequency Division Multiplexing (OFDM)

OFDM uses also multiple sub-carriers, though the sub-carriers are closely spaced to each other without causing interference, removing guard bands between adjacent sub-carriers. This is possible due to the frequencies (sub-carriers) are orthogonal, it means, the peak of one sub-carrier coincides with the null of an adjacent sub-carrier.

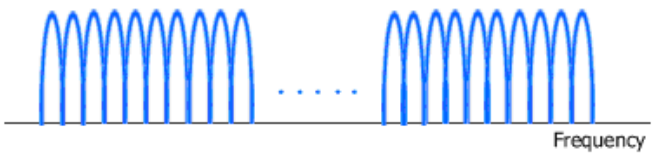


Figure 3–7 Orthogonal Frequency Division Multiplexing (OFDM)

In OFDM system, a high rate data stream is divided into multiple parallel low rate data streams. Each smaller data stream is the mapped to individual data sub-carrier and modulated using some sorts of PSK (Phase Shift Keying) or QAM (Quadrature Amplitude Modulation), i.e. BPSK, QPSK, 16-QAM, 64-QAM.

OFDM requires less bandwidth than FDM to carry the same amount of information. Besides a high spectral efficiency, an OFDM system such as WiMAX is more resilient in NLOS (Non-Line of Sight) environment. It can efficiently overcome interference

and frequency-selective fading caused by multi-path because equalizing is done on a subset of sub-carriers instead of a single broader carrier.

Orthogonal Frequency Division Multiple Access (OFDMA)

OFDMA employs multiple closely spaced sub-carriers, but the sub-carriers are divided into groups of sub-carriers. Each group is named a sub-channel. The sub-carriers that form a sub-channel do not need to be adjacent. In the downlink, a sub-channel may be intended for different receivers. In the uplink, a transmitter may be assigned one or more sub-channels.

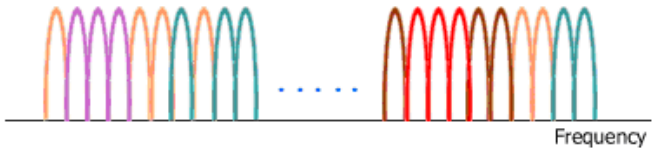


Figure 3–8 Orthogonal Frequency Division Multiple Access (OFDMA)

Subchannelization defines sub-channels that can be allocated to subscriber stations (SSs) depending on their channel conditions and data requirements. Using subchannelization, within the same time slot a Mobile WiMAX Base Station (BS) can allocate more transmit power to user devices (SSs) with lower SNR (Signal-to-Noise Ratio), and less power to user devices with higher SNR. Subchannelization also enables the BS to allocate higher power to sub-channels assigned to indoor SSs resulting in better in-building coverage.

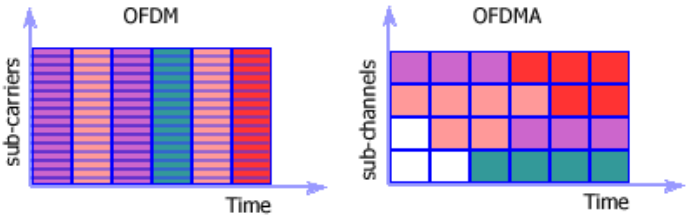


Figure 3–9 Uplink Subchannelization in WiMAX

In OFDM, only one SS transmits in one time slot. In OFDMA, several SSs can transmit at the same time slot over several sub-channels.

Subchannelization in the uplink can save a user device transmit power because it can concentrate power only on certain sub-channel allocated to it. This power-saving feature is particularly useful for battery-powered user devices, the likely case in Mobile WiMAX.

Scalable OFDMA (SOFDMA)

SOFDMA adds scalability to OFDMA. It scales the FFT (Fast Fourier Transform) size to the channel bandwidth while keeping the sub-carrier frequency spacing constant across different channel bandwidths. Smaller FFT size is given to lower bandwidth channels, while larger FFT size to wider channels. By making the sub-carrier frequency spacing constant, SOFDMA reduces system complexity of smaller channels and improves performance of wider channels.

As a reminder, IFFT (Inverse Fast Fourier Transform) is used in a WiMAX transmitter to create an OFDM waveform from modulated data streams, while FFT is used in a WiMAX receiver to demodulate the data streams. The FFT size equals the number of sub-carriers, e.g. in OFDM/OFDMA system with 256 sub-carriers, the FFT size is 256.

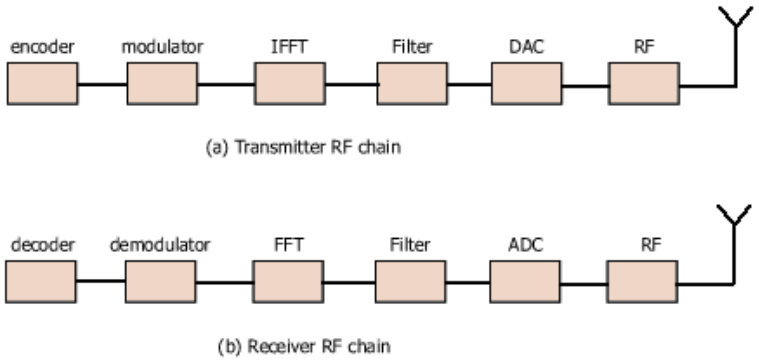


Figure 3–10 Transmitter and Receiver RF chains in WiMAX

SOFDMA is the OFDMA mode used in Mobile WiMAX. It supports channel bandwidths ranging from 1.25 MHz to 20 MHz. With bandwidth scalability, Mobile WiMAX technology can comply with various frequency regulations worldwide and flexibly address diverse operator or ISP (Internet Service Provider) requirements, that is whether for providing only basic Internet service or a broadband service.

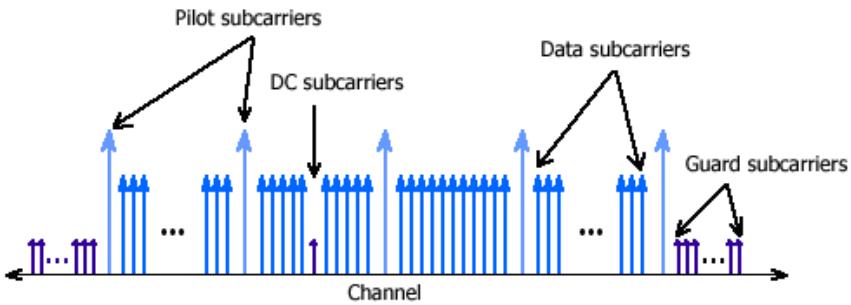


Figure 3–11 OFDM symbol structure in WiMAX

Both OFDM and OFDMA symbols are structured in similar way. Each symbol consists of:

- data sub-carriers (OFDM) or sub-channels (OFDMA) that carry data
- pilot sub-carriers as reference frequencies and for various estimation purposes
- DC sub-carrier as the center frequency
- guard sub-carriers or guard bands for keeping the space between OFDM/ OFDMA signals.

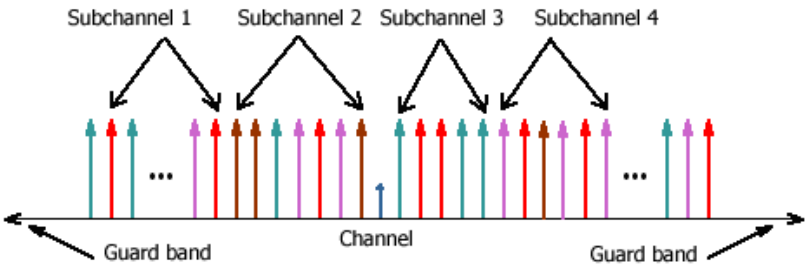


Figure 3–12 OFDMA symbol structure in WiMAX (sub-carriers of the same color represent a sub-channel)

Note: There are these material (attached) offered by WiMAX Forum [3] that can contribute for more details about WiMAX system, modulation, application, etc.

4
Getting Started with TEMS CellPlanner

The first time you use TEMS CellPlanner, read the chapter *Using TEMS CellPlanner* in the *TEMS CellPlanner Common Features User's Guide*

Here you find information on

- how to start and exit TEMS CellPlanner
- how to use the windows, menus and explorers

5
WiMAX Project

This chapter describes how to initiate and save a project, and how to configure the WiMAX specific project parameters. After having setup your project using the procedures in this chapter, proceed with the subsequent chapters to build your WiMAX network plan.

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WiMAX Project Parameters 5-5
Default WiMAX Modulation and Coding Schemes (MCSs) 5-5
Configure WiMAX Project Parameters 5-5

About WiMAX Projects

A WiMAX network plan is developed within a project, stored as a file for single-user access, or in a database on a TEMS CellPlanner server to be shared with other planners.

Note: *Your changes to the network plan are stored persistently first when you explicitly **save** the project. The **apply** operations in the tool do not save changes to the project persistently.*

Working with a WiMAX Project

The order of procedures in this chapter follows a standard order for defining a project in TEMS CellPlanner.

Procedures in *italic* font are described in the *TEMS CellPlanner Common Features User's Guide* (default) or the *TEMS CellPlanner GeoData User's Guide*.

Create or Open a Project

Start your work with the network plan by creating a new TEMS CellPlanner project, or open an existing TEMS CellPlanner project to modify an initiated project.

Prerequisites

TEMS CellPlanner Client is started.

Procedures

To create a new project, see *Define General Project Settings*

To open an existing project, see *Open Existing Project.*

Note: *If the project is or shall be stored in database on a server, see instead chapter Working with Projects on Server.*

Define Project Specific Information

The project specific information is configured from **File↗Project settings**. If you share the project with other planners, these settings apply for all users of the project.

Prerequisites

A project is opened.

Procedures

Use the following procedures to define project specific information:

1. Define General Project Settings
2. Select Coordinate System for Project
3. Add Map Layers to Project

Note: *You must add map layers in two places:*
a. The map layers in the ***Project settings*** *are used by propagation models, and are needed as input to the pathloss calculations.*

*b. The map layers in the **Map properties** are displayed on screen, see TEMS CellPlanner Common Features User's Guide.*

4. Define Object Names
5. Configure technology dependent information, see Configure WiMAX Project Parameters on page 5-5.

Define User Specific Information

The user specific information is configured from **File↗User settings**. If you share the project with other planners, the user settings apply only to a single user and override default project settings.

Prerequisites

A project is opened.

Procedure

Use the procedure *Define User Settings* to define user specific information.

Check, Save and Close a Project

Your changes to a project must be saved as a project file or in database to be kept persistently. Before saving it is recommended to check the consistency of the project.

Prerequisites

A project is opened.

Procedures

Use the following procedures to check, save and close a project:

1. Check Project Consistency
2. Save Project

Note: *If the project is or shall be stored in database on a server, see instead chapter Working with Projects on Server.*

3. Close Project

WiMAX Project Parameters

All users of a WiMAX project must select from the same set of Modulation and Coding Schemes (MCSs) and use some other global WiMAX parameters. These parameters are configured as project parameters.

Default WiMAX Modulation and Coding Schemes (MCSs)

The default MCSs in the table below appear the first time you configure the WiMAX project parameters, see Configure WiMAX Project Parameters on page 5-5.

MCS name	Bit rate (kbps)	Bit rate with cyclic prefix	Receiver threshold (dBm)	C/(I+N) threshold (dB)
BPSK 1/2	1500.0	1312.5	-90.9	6.4
QPSK 1/2	2900.0	2537.5	-87.9	9.4
QPSK 3/4	4400.0	3850.0	-85.1	11.2
16QAM 1/2	5800.0	5075.0	-79.9	16.4
16QAM 3/4	8700.0	7612.5	-77.7	18.2
64QAM 2/3	11600.0	10150.0	-73.3	22.6
64QAM 3/4	13100.0	11462.5	-71.5	24.4

These default MCSs are valid for a WiMAX system with a channel bandwidth of 3.5 MHz operating on the 3.5 GHz band, when the whole carrier bandwidth is utilized 100% of the time with the cyclic prefix 12.5%.

To read more about modulation and coding schemes, see About WiMAX Modulation and Coding Schemes (MCSs) on page 7-19.

Configure WiMAX Project Parameters

You configure the global WiMAX parameters as project parameters.

Prerequisites

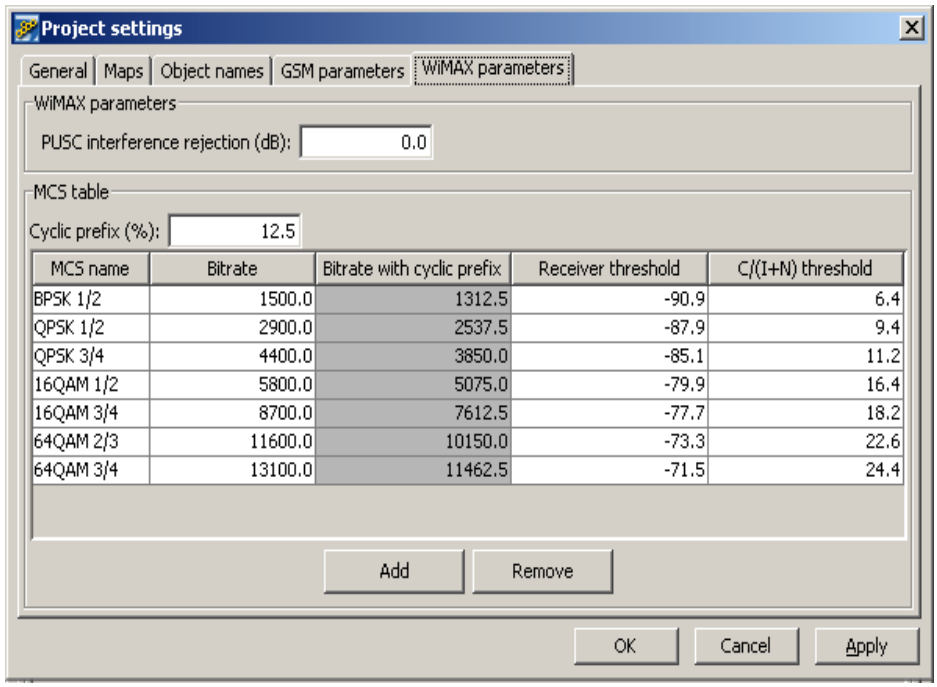
A project is opened.

Procedure

Follow these steps to define WiMAX parameters for a project:

1. Select **File↗Project settings/WiMAX parameters** to display the **WiMAX parameters** window. The first time you open this window, a set of default

MCSs are displayed, see Default WiMAX Modulation and Coding Schemes (MCSs) on page 5-5.



2. Add, remove or edit MCSs in the MCS table.
3. Change the other WiMAX parameter settings as required.
4. Click **Apply** to preserve the settings.

Fields on Window "Project Settings - WiMAX Parameters"

Field	Description
PUSC interference rejection (dB)	The attenuation factor for interference between co-sited cells when PUSC is used at the site. When different sub-carriers are scheduled for each co-sited cell, this factor becomes very high. Range 0 - 100. Default = 16.0.
Cyclic prefix (%)	A repetition of the last samples of the data symbol attached to the beginning of the data symbol. The cyclic prefix can completely eliminate inter-symbol interference, as long as the cyclic prefix duration is longer than the channel delay spread. Range 0-100. Default = 12.5.
MCS table - A list of modulation and coding schemes	
MCS name	Name of the modulation and coding scheme. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Bitrate	Bit rate without cyclic prefix, measured in kbps
Bitrate with cyclic prefix	Measured in kbps. Not editable. Updated from Betrayed and Cyclic prefix when you select Apply.
Receiver threshold	Threshold of signal strength. Measured in dBm.
C/(I+N) threshold	Measured in dB
Add	Add an MCS
Remove	Remove selected MCS
OK	Apply all changes and close the window
Cancel	Cancel all changes
Apply	Apply all changes

6
Working with TEMS CellPlanner Server

You can share your WiMAX network plan with other planners by storing it on a TEMS CellPlanner server.

Read more about sharing network plans in *Working with Projects on Server* and *Administering Database Users and Projects* in the *TEMS CellPlanner Common Features User's Guide*.

7
WiMAX System Data and Services

This chapter describes how to define the system data and services of a WiMAX network plan.

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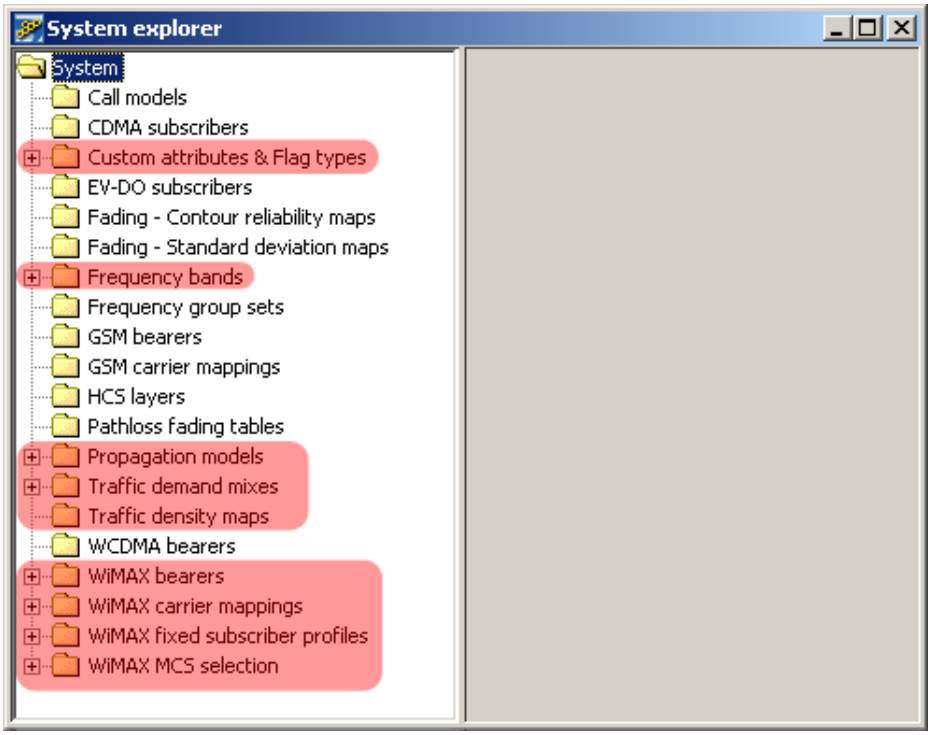
About WiMAX System Data and Services

Before adding sites, RBSs and cells you need to define the system data and services to be used in your WiMAX network. S*ystem data* may be common for WiMAX and other technologies. *Services* are technology dependent, that is, the WiMAX services defined in a WiMAX network plan only.

You can add or delete system data and services using the right-click mouse menus in the **System explorer**. In the figure below, the system data and services relevant for WiMAX are highlighted:



The standard flow of planning system data and services in a WiMAX network with TEMS CellPlanner is reflected in the order of procedures in this chapter and in the list below:

1. **WiMAX carrier mappings** - UL and DL sub-carriers and sub-channels
2. **Frequency bands** - WiMAX frequency bands with carrier selection
3. **WiMAX bearers** - UL and DL bit rates and frequency bands
4. **WiMAX MCS selections** - allowed sets of modulation and coding schemes
5. Propagation models - land use category dependent radio wave behavior
6. Traffic density maps - optional, land use category dependent traffic density
7. Traffic demand mix - a mix of traffic with different traffic demands

8. **Traffic demand** - distribution of terminal types in the WiMAX network, optionally with geographical distribution
9. **WiMAX fixed subscriber profiles** - antenna and load from non-mobile and nomadic end users complying to standard IEEE 802.16d (2004)
10. Custom attributes and flag types - of WiMAX RBS, cell and fixed subscriber

The **bold** WiMAX services and system data are described with procedures in this *TEMS CellPlanner WiMAX User's Guide*. Other system data are described in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX Carrier Mappings

A *WiMAX carrier mapping* defines a single configuration including UL and DL sub-carriers and sub-channels, and the time fraction used for UL and DL traffic respectively.

Define WiMAX Carrier Mapping

You can define several WiMAX carrier mappings depending on how you want to dispose your sub-carriers and sub-channels and the time fraction reserved for UL and DL respectively.

At a later stage in the planning, you select one carrier mapping for the frequency band to use in your WiMAX network plan., see Define WIMAX Frequency Band on page 7-7.

Prerequisites

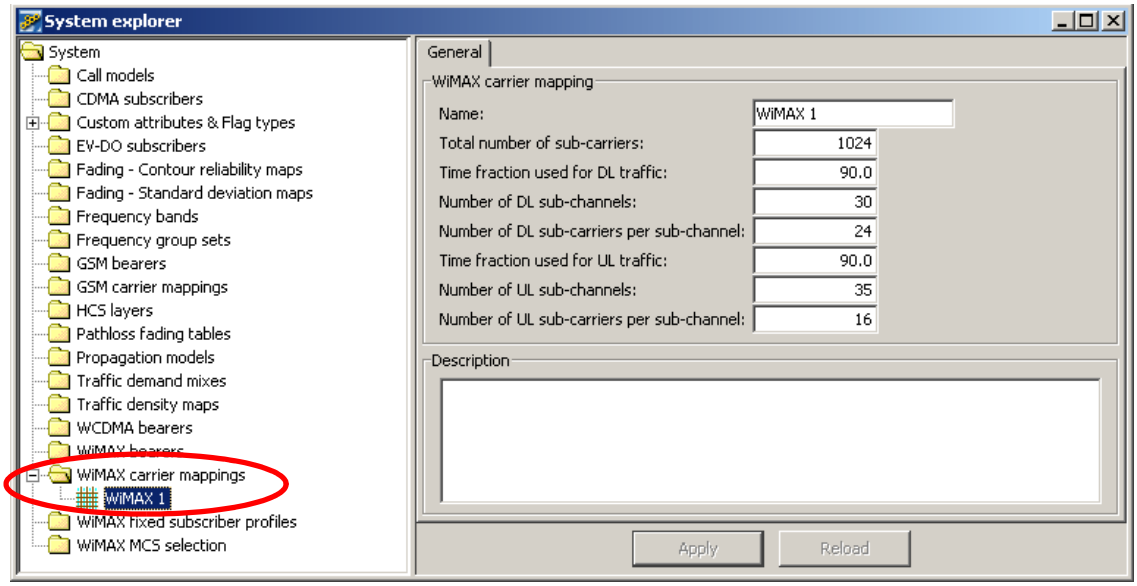
A WiMAX project is opened.

Procedure

1. Select **Utilities↗System explorer**.
2. To create a new carrier mapping, right-click the **WiMAX carrier mapping** folder and select **Add carrier mapping**.

   To modify an existing carrier mapping, select the carrier mapping in the **WiMAX carrier mapping** folder.

3. The **WiMAX carrier mapping - General** tab is displayed:



4. Name the carrier mapping and enter the other parameters as required.
5. Click **Apply** to preserve the carrier mapping settings.

Fields on Window "WiMAX Carrier Mapping - General"

Field	Description
Name	Name of the carrier mapping. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Total number of sub-carriers	Range: 0 - 10000. Default = 1024.
Time fraction used for DL traffic	Range: 0 - 100%. Default = 90%. In S-TDD and half-duplex FDD mode, the carrier mapping parameters **Time fraction used for DL traffic** and **Time fraction used for UL traffic** must have a sum less than or equal to 100%. See Define WIMAX Frequency Band on page 7-7.
Number of DL sub-channels	Range: 1 - 1000. Default = 30.
Number of DL sub-carriers per sub-channel	Range: 1 - 1000. Default = 24.
Time fraction used for UL traffic	Range: 0 - 100%. Default = 90%. In S-TDD and half-duplex FDD mode, the carrier mapping parameters **Time fraction used for DL traffic** and **Time fraction used for UL traffic** must have a sum less than or equal to 100%. See Define WIMAX Frequency Band on page 7-7.

Field	Description
Number of UL sub-channels	Range: 1 - 1000. Default = 35.
Number of UL sub-carriers per sub-channel	Range: 1 - 1000. Default = 16.
Description	Description of the carrier mapping

WiMAX Frequency Bands

A WiMAX f*requency band* consists of a number of configurable carriers.

In FDD mode, different carriers are used for downlink and uplink respectively, with a frequency distance defined by the duplex distance. In S-TDD mode, the same carrier is used for downlink and uplink.

The carriers are defined in a *carrier mapping*. A WiMAX frequency band can be assigned one carrier mapping.

The IEEE standard 802.16-2004, Annex B, specifies 14 frequency bands, some of them including sub-bands.

Predefined WiMAX Frequency Band

TEMS CellPlanner provides a predefined frequency band, with parameter values according to the table below:

Parameter	Initial Value
Base frequency	2300.0 MHz
Base channel	1
Duplex type	FDD
Duplex distance (MHz)	50.0 MHz
DL upper edge (MHz)	2302.25 MHz
DL lower edge (MHz)	2300.0 MHz
UL upper edge (MHz)	2252.25 MHz
UL lower edge (MHz)	2250.0 MHz
Carrier bandwidth	3.5 MHz
Base sub-band	
Lower edge channel	1
Upper edge channel	10
Number of carriers	10
Carrier distance	1
Lower edge frequency	2300.0 MHz
Upper edge frequency	2302.5 MHz
Channel separation	0.25 MHz

Define WIMAX Frequency Band

Use this procedure to add and configure a frequency band.

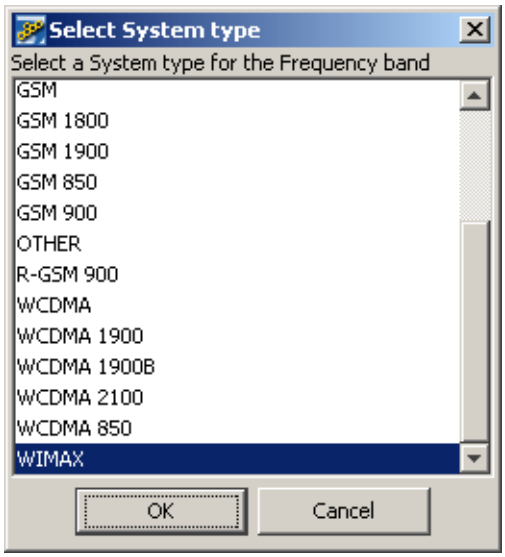
Prerequisites

- A WiMAX project is opened.

- A WiMAX carrier mapping is defined, see Define WiMAX Carrier Mapping on page 7-4. A carrier mapping is required in S-TDD mode, and recommended in FDD mode. If no carrier mapping is selected, default values are used.

Procedure

1. Select **Utilities↗System explorer.**
2. Right-click the **Frequency Band** folder and select **Add Frequency band**. The **Select System type** window is displayed. This window shows the predefined system types, that is, combinations of Radio Access Technology and frequency band:



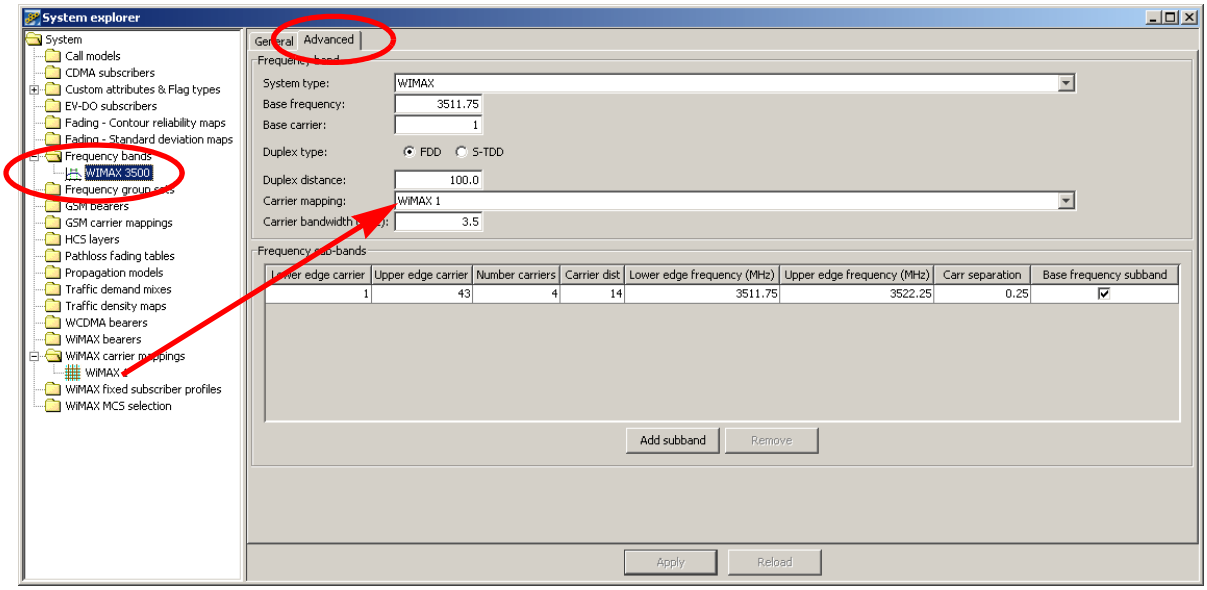
3. Select the **WiMAX** system type and click The **Frequency band - General** window appears.
4. Click the **Advanced** tab. The **Frequency band - Advanced** window is displayed. An initial WiMAX base sub-band is created, see Predefined WiMAX Frequency Band on page 7-7.
5. Select duplex type **FDD** or **S-TDD**.
6. Select a carrier mapping.

Note: *In S-TDD and half-duplex FDD mode, the carrier mapping parameters **Time fraction used for DL traffic** and **Time fraction used for UL traffic** must have a sum less than or equal to 100%.*

7. Modify the other parameters in the Frequency band pane as required.
8. Modify the following Frequency sub-band parameters of the base sub-band as required: **Lower edge carrier, Upper edge carrier, Number of carriers, Carrier distance, Carrier separation**.

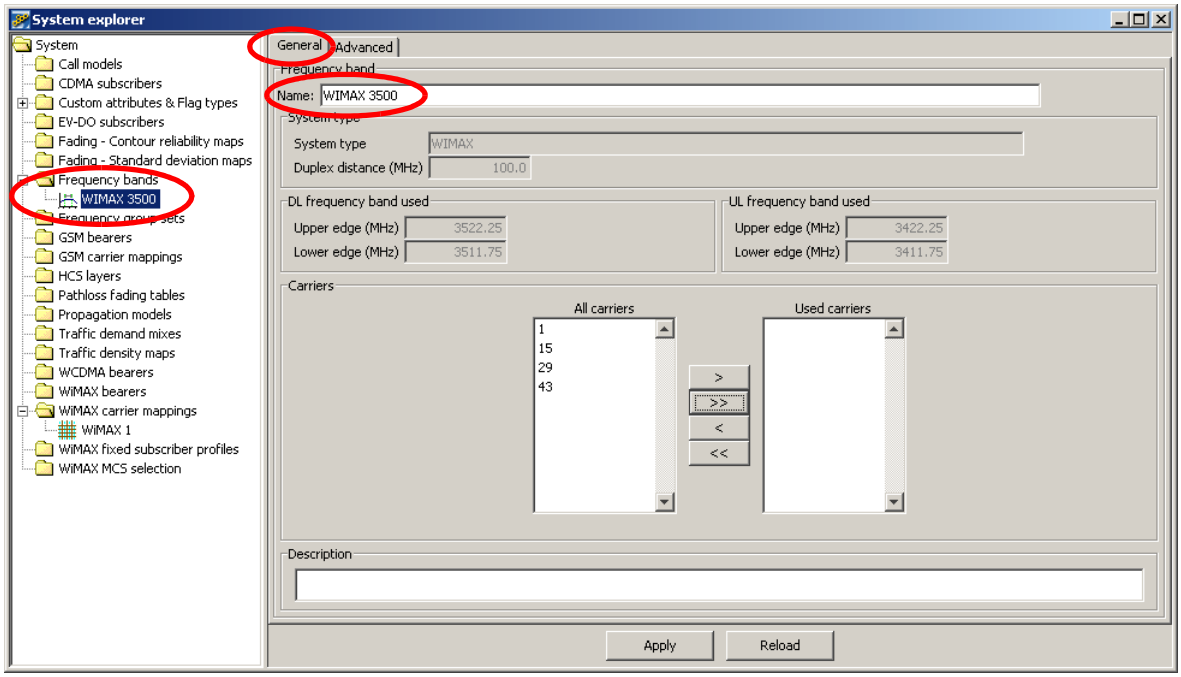
The lower and upper edge frequency parameters are updated automatically.

9. Ensure that the **Base frequency subband** option is selected.
10. The result looks as in the following example:



11. Click the **General** tab. The **Frequency band - General** window is displayed. The parameters are updated from the settings in the **Advanced** tab.

12. Enter a name of the frequency band. The result now looks as in the following example:



13. Click **Apply** to preserve the settings of the frequency band.
14. Proceed with Step 4 in Add Carriers to Frequency Band on page 7-13.

Fields on Window "Frequency Band - General"

Field	Description
Name	Name of the frequency band. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
System type	
System type	The system type for the frequency band, set to "WiMAX" when the system type is selected. Not editable.
Duplex distance (MHz)	The distance in MHz between uplink and downlink frequencies. Editable and used only if FDD selected in the Advanced tab.
DL frequency band used	
Upper edge (MHz)	The upper edge of the downlink frequency band. Not editable.
Lower edge (MHz)	The lower edge of the downlink frequency band. Not editable.
UL frequency band used	
Upper edge (MHz)	The upper edge of the UL frequency band. If S-TDD selected automatically set to the same value as DL upper edge. Not editable.
Lower edge (MHz)	The lower edge of the UL frequency band. If S-TDD selected, automatically set to the same value as DL lower edge. Not editable.
Carriers	
All carriers	All possible channel numbers, not yet selected for the frequency band. The number of possible carriers and their distance are defined in the base sub-band settings, see Fields on Window "Frequency Band - Advanced" on page 7-11.
Used carriers	All selected channel numbers for the frequency band.
Description	Description of the frequency band.

Fields on Window "Frequency Band - Advanced"

Field	Description
System type	Indicates the technology WiMAX
Base frequency (MHz)	The base frequency for the frequency band, derived from the lower edge frequency of the base sub-band (with option Base frequency selected). The base frequency is identical to the lower edge frequency of the base sub-band.

Field	Description
Base carrier	The base carrier for the frequency band, derived from the lower edge carrier of the base sub-band (with option Base frequency selected). The base carrier is identical to the lowest carrier of the base sub-band.
Duplex type	FDD (default) or S-TDD. To configure half-duplex FDD: Select FDD and set UL/DL time fraction parameters according to the description of parameter **Carrier mapping**.
Duplex distance (MHz)	The distance in MHz between uplink and downlink frequencies. Editable only if the FDD option is selected.
Carrier mapping	The carrier mapping of a frequency band. A carrier mapping is required in S-TDD mode, and recommended in FDD mode. If no carrier mapping is selected, default values are used. In S-TDD and half-duplex FDD mode, the carrier mapping parameters **Time fraction used for DL traffic** and **Time fraction used for UL traffic** must have a sum less than 100%. See Define WiMAX Carrier Mapping on page 7-4.
Carrier bandwidth (MHz)	The bandwidth of one carrier in MHz. Range: 1.25 - 20. Default = 3.5.
Frequency band sub-bands - List of sub-bands. The base sub-band is also counted as a sub-band in this context.	
Lower edge carrier	The channel number delimiting the lower edge of the frequency band.
Upper edge carrier	The channel number delimiting the upper edge of the frequency band.
Number of carriers	Number of carriers of the sub-band. Default: 10.
Carrier distance	The distance interval between carriers.
Lower edge frequency (MHz)	The DL lower edge frequency of the sub-band.
Upper edge frequency (MHz)	The DL upper edge frequency of the sub-band.
Carrier separation (MHz)	Separation interval in MHz between each carrier.
Base frequency subband	Enabled if this is the base band, not a sub-band, of the frequency band. Exactly one sub-band shall have this option selected, thus making it a base sub-band.
Add subband	Adds a subband to the frequency band.
Remove	Removes a selected subband from the frequency band.

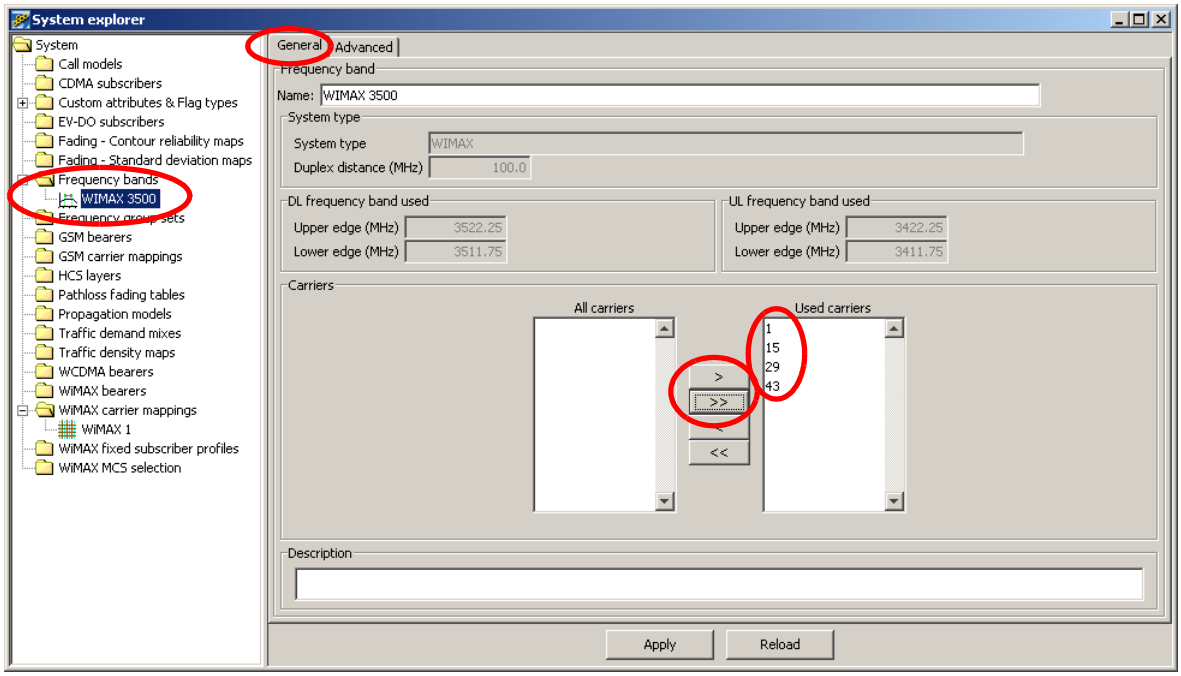
Add Carriers to Frequency Band

Prerequisite

A WiMAX frequency band has been defined, see Define WIMAX Frequency Band on page 7-7.

Procedure

1. Select **Utilities↗System explorer.**
2. Select the frequency band for which to add carriers.
3. Select the **General** tab. The **Frequency band - General** window appears.
4. Select carriers from the **All carriers** list. Click **>>** to select all carriers, or **>** to select specific carriers. The selected carriers are moved to the **Used carriers** list.
5. The result looks as in the following example:



6. To deselect carriers, click **<<** to deselect all carriers, or **<** to deselect specific carriers
7. Click **Apply** to preserve the carrier selection.

Fields on the Window

See Fields on Window “Frequency Band - General” on page 7-11.

Define WiMAX Frequency Band Sub-band

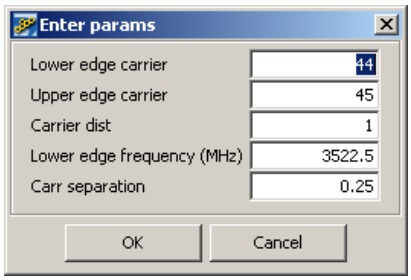
Some frequency bands may contain two sub-bands with different properties. You customize such WiMAX frequency bands by adding the sub-bands and configure their respective properties.

Prerequisites

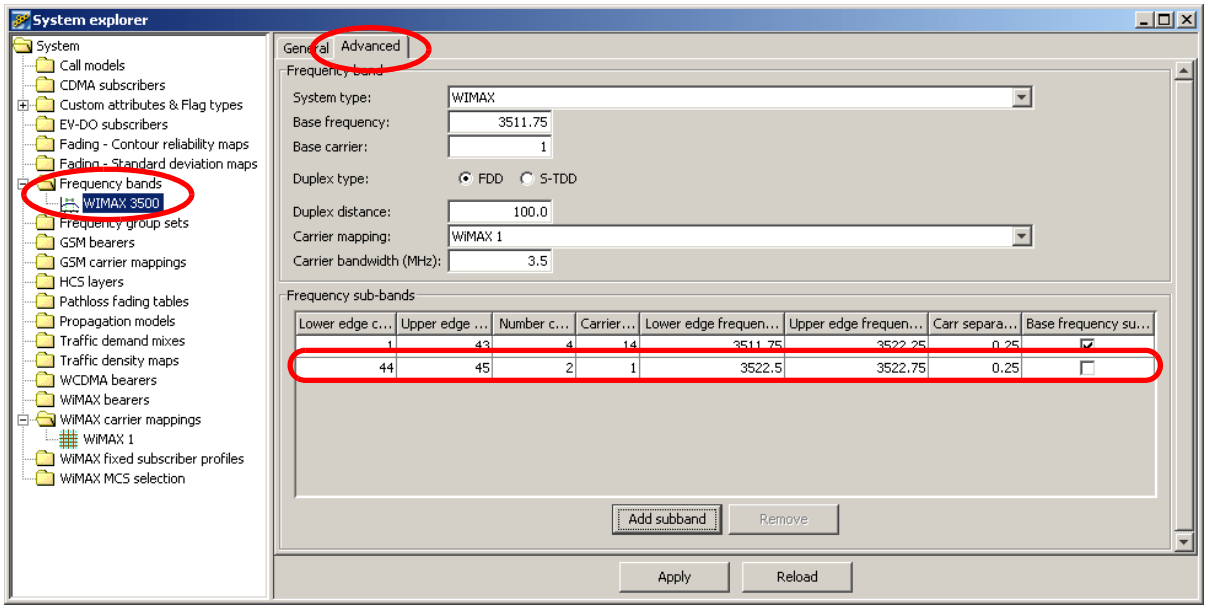
A WiMAX frequency band has been defined, see Define WIMAX Frequency Band on page 7-7.

Procedure

1. Select **Utilities↗System explorer.**
2. Select the frequency band for which to add or modify sub-bands.
3. Select the **Advanced** tab. The **Frequency Band - Advanced** window is displayed.
4. Click **Add sub-band.** A window with the sub-band parameters appears:



5. Modify the parameters as required and click **OK**. The new sub-band appears in the **Frequency band - Advanced** window:



6. Click **Apply** to preserve the new sub-bands.
7. In the **Frequency band - General** tab you can see that the new sub-band has been added to the **All carriers** list.

Fields on the Window

See Fields on Window "Frequency Band - Advanced" on page 7-11.

WiMAX Bearers

A *WiMAX bearer* is characterized by its frequency band, one selected carrier and its average DL and UL bitrate.

The WiMAX bearers are part of:

- terminal definitions, see WiMAX Terminal Types on page 8-4
- traffic cases in analysis functions, see About Traffic Cases in WiMAX Analysis on page 14-2.

Define WiMAX Bearers

A WiMAX bearer is associated with exactly one carrier.

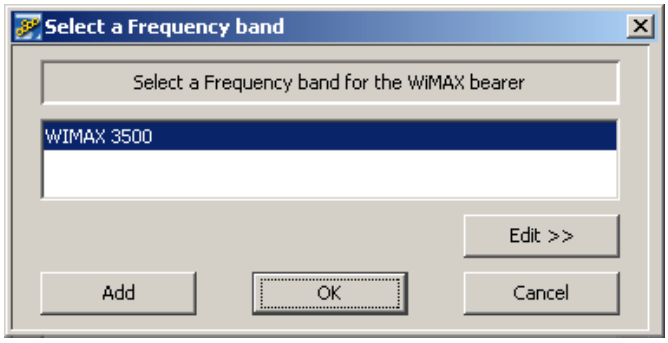
Prerequisites

A frequency band with carriers must be defined, see Define WIMAX Frequency Band on page 7-7.

Procedure

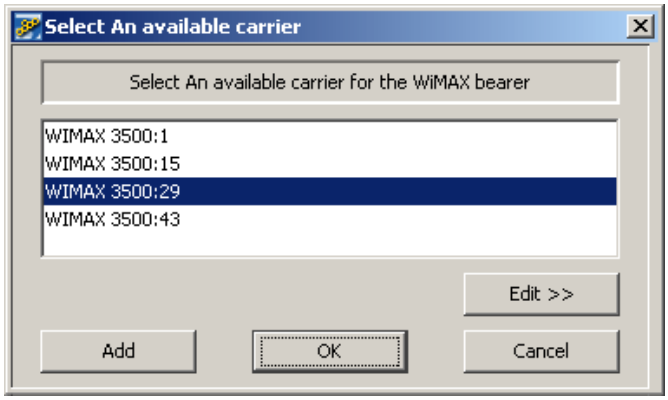
Follow these steps to define a WiMAX bearer:

1. Select **Utilities↗System explorer**.
2. Right-click the **WiMAX bearers** folder and select **Add WiMAX bearer** from the menu. The **Select a frequency band** dialog appears:

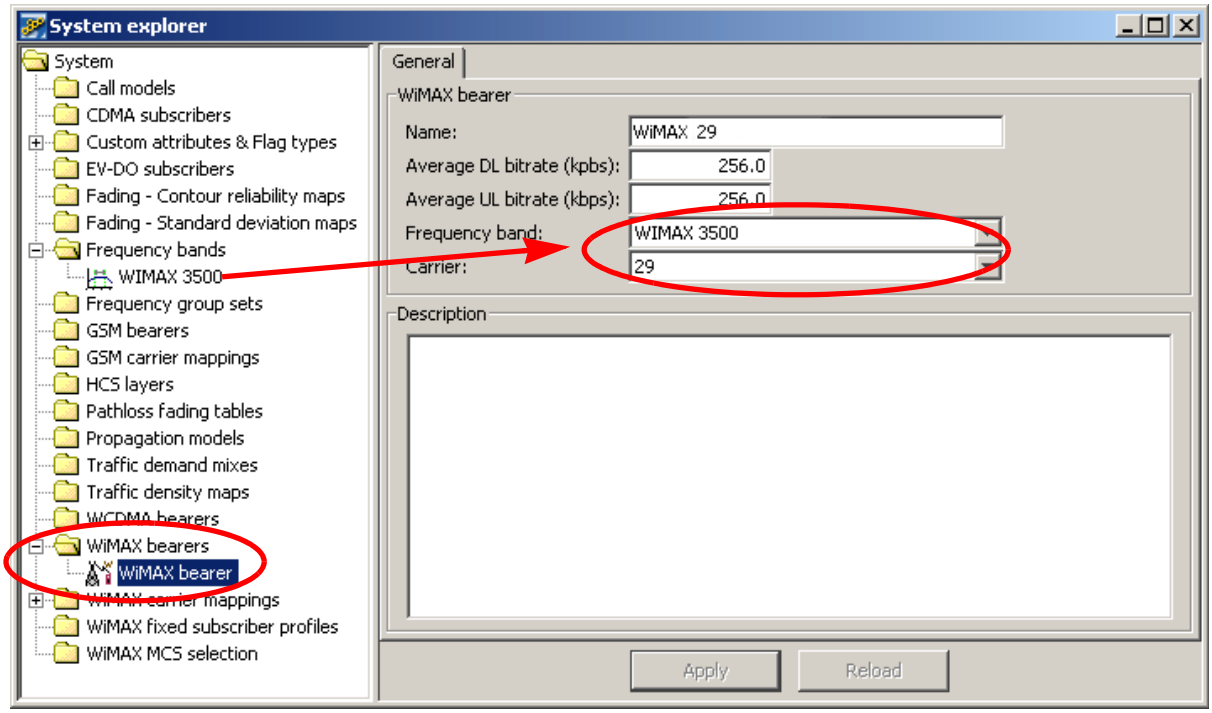


Note: *If you have not added any carrier to the frequency band, as described in Add Carriers to Frequency Band on page 7-13, a new wizard will be opened to allow you to select carriers now. This wizard is not described here.*

3. Select a frequency band. The **Select an available carrier** dialog appears:

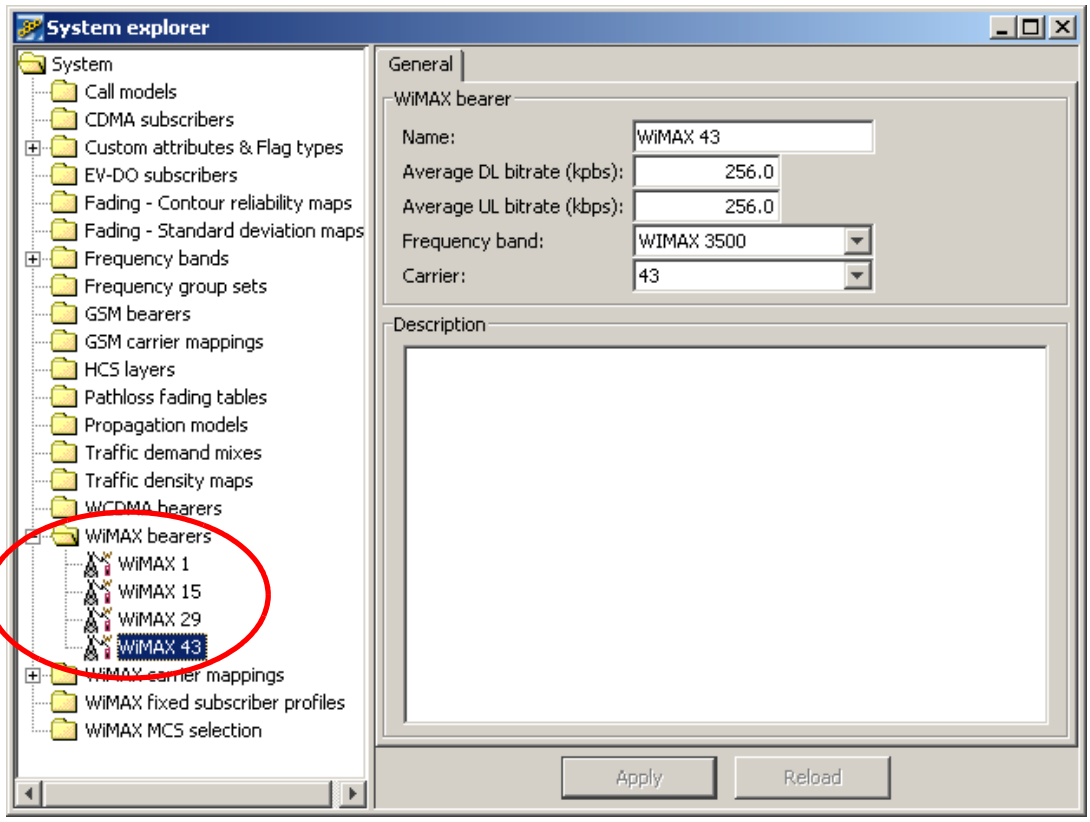


4. Select a carrier and click **OK**. The **WiMAX bearer - General** tab appears with the frequency band and carriers selected in previous steps:



5. Enter a name of the WiMAX bearer.
6. Modify the other parameters as required.
7. Click **Apply** to preserve the settings of the WiMAX bearer.

8. Repeat the procedure until you have defined one WiMAX bearer per carrier. The result then looks as in the following example:



The WiMAX bearers can be included in the terminal types, see Define WiMAX Terminal Types on page 8-5.

Fields on Window "WiMAX Bearer"

Field	Description
Name	Name of the WiMAX bearer. Maximum 128 alphabetical or numerical characters. Do not use / ,\,' or %.
Average DL bitrate (kbps)	Range: 0 - 100000. Default = 256.
Average UL bitrate (kbps)	Range: 0 - 100000. Default = 256.
Frequency band	Frequency band for the bearer, selected from list of defined frequency bands. Only one frequency band can be selected.
Carrier	Carrier for the bearer, selected from the list of carriers defined for the frequency band. Only one carrier can be selected.
Description	Description of the WiMAX bearer

WiMAX MCS Selections

About WiMAX Modulation and Coding Schemes (MCSs)

A *Modulation and Coding Scheme (MCS)* is a data frame where the size, coding and modulation type of the frame is adapted to suit a specific technology.

The MCSs allowed in a WiMAX project are configured as project parameters, see Configure WiMAX Project Parameters on page 5-5.

Define WiMAX MCS Selection

Each terminal is associated with at least one set - *MCS selection* - of allowed modulation and coding schemes (MCSs), as described in Define WiMAX Terminal Types on page 8-5.

The MCS selections affect the results of the WiMAX analysis.

A WiMAX project may have different MCS selections for DL and UL, and for different terminal types.

Prerequisites

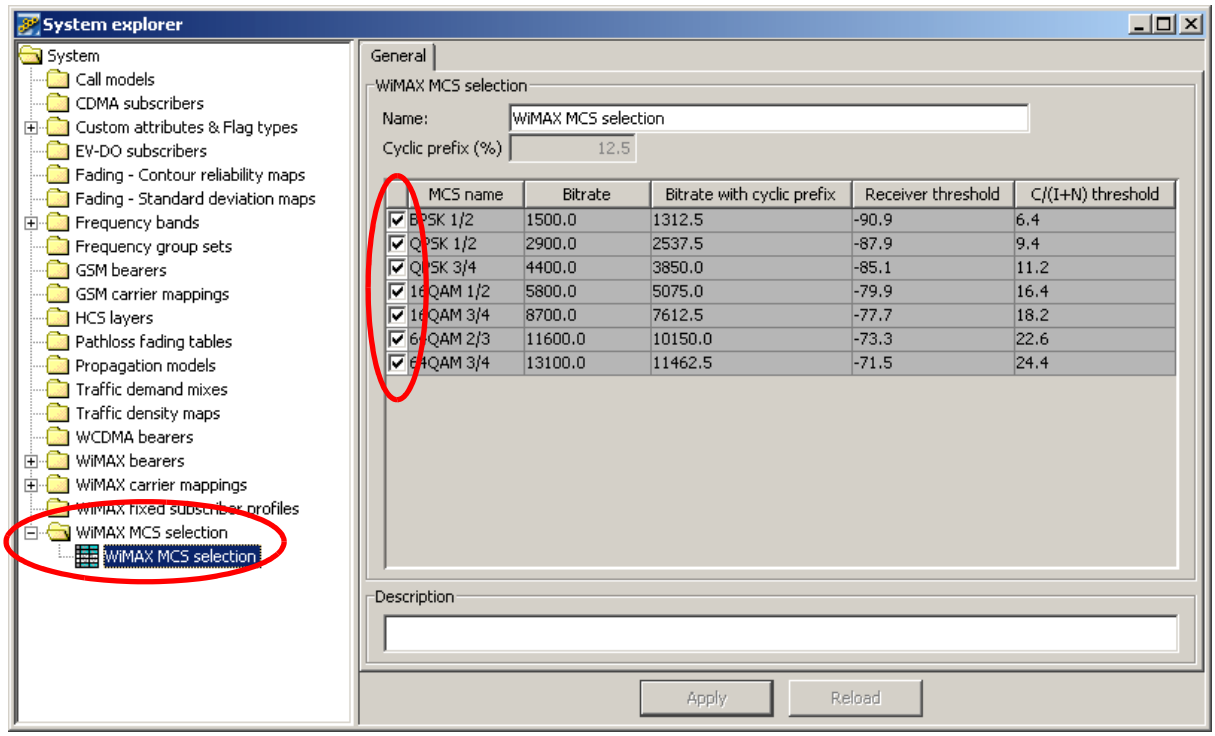
The MCSs allowed in the project are configured, see Configure WiMAX Project Parameters on page 5-5.

Procedure

Follow these steps to define a WiMAX MCS selection:

1. Select **Utilities↗System explorer**.

2. Right-click the **WiMAX MCS selection** folder and select **Add WiMAX MCS selection** from the menu. The **WiMAX MCS selection - General** tab appears, including all allowed modulation and coding schemes:



3. Give the MCS selection an appropriate name.
4. Select the MCSs to be used in your project by checking or clearing the check boxes.
5. Click **Apply** to preserve the MCS selection.

Fields on Window "WiMAX MCS Selection"

Field	Description
Name	Name of the MCS selection. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Cyclic prefix (%)	A repetition of the last samples of the data symbol attached to the beginning of the data symbol. The cyclic prefix can completely eliminate inter-symbol interference, as long as the cyclic prefix duration is longer than the channel delay spread. Range 0-100. Default = 12.5.

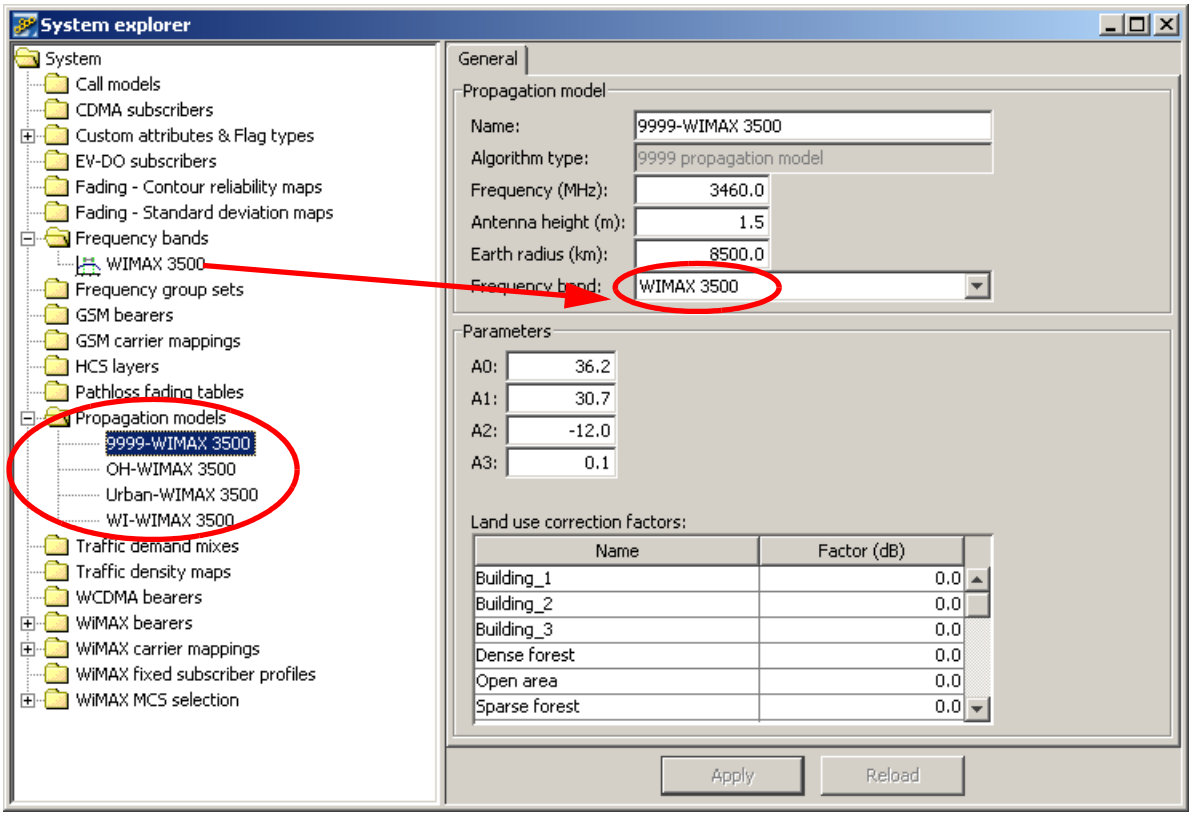
Field	Description
MCS name	Name of the modulation and coding scheme. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Bitrate	Bitrate without cyclic prefix, measured in kbps
Bitrate with cyclic prefix	Measured in kbps. Not editable. Updated from Bitrate and Cyclic prefix when you select Apply.
Receiver threshold	Threshold of signal strength. Measured in dBm.
C/(I+N) threshold	Measured in dB.
Description	Description of the WiMAX bearer

WiMAX Propagation Models

You need to define propagation models for your WiMAX project, for pathloss calculations towards:

- mobile terminals
- fixed subscribers, see About WiMAX Fixed Subscribers on page 14-10

The example below shows a set of four propagation models, all with default values. Each propagation model is associated with a WiMAX frequency band:



How to define the propagation models is described in the *TEMS CellPlanner Common Features User's Guide*, in the following chapters:

- Define Propagation Model Types
- Ericsson 9999 Propagation Model
- Urban Propagation Model
- Okumura-Hata Propagation Model
- Walfish-Ikegami Model

The propagation models are further included in each antenna branch in your WiMAX project: One propagation model for mobile terminals, and one point-to-

point propagation model for fixed subscribers. Read more about antenna branches in About Antenna Branches on page 9-10.

To learn more about propagation models, see chapter *Propagation Models* in the *TEMS CellPlanner Common Features Technical Reference Manual*.

Traffic Density and Traffic Demand

You need to define at least one traffic demand mix with one or more traffic demands. The traffic demand mix is used in WiMAX Interference Analysis and WiMAX Traffic Performance Analysis.

The *traffic density* is the amount of traffic per area in your network.

A *traffic demand* is the traffic density of a bearer with a certain distribution of terminals in the network. The traffic demand can be either uniform or non-uniform:

- With *non-uniform traffic demand*, the traffic density depends on the land use category. You define the traffic density per land use category in a t*raffic density map*.
- With *uniform traffic demand*, the traffic density of the bearer is assumed to be the same in all bins and for all land use categories, thus no traffic density map is needed.

A *traffic demand mix* is a combination of traffic demands from different services expected in the network. By including traffic demands with different DL and UL rate in a traffic demand mix, you can model a WiMAX network with unsymmetrical traffic load.

Define WiMAX Traffic Demand Mix

Use this procedure to combine traffic demands in a traffic demand mix.

Read more about traffic demand mix in Traffic Density and Traffic Demand on page 7-24.

Prerequisites

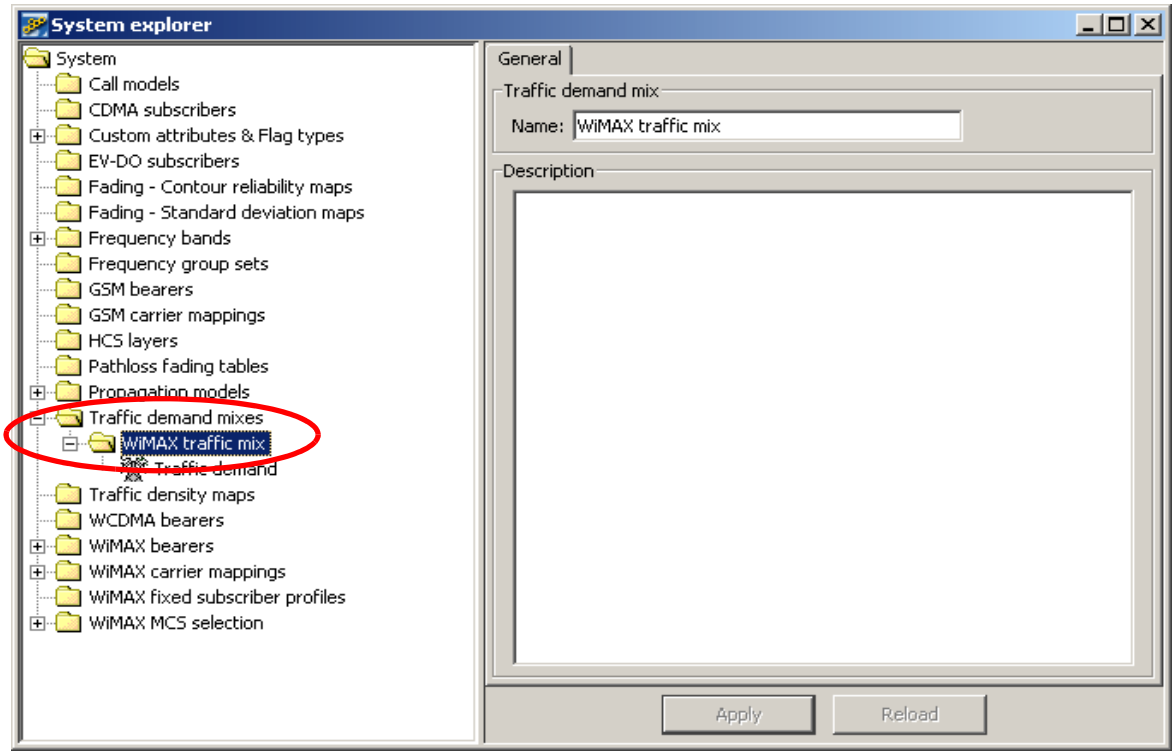
See prerequisites of Define WiMAX Traffic Demand on page 7-25.

Procedure

Follow these steps to define traffic demand mixes:

1. Select **Utilities↗System Explorer.**
2. Right-click the **Traffic demand mix folder** and select **Add Traffic demand mix**. One traffic demand object is added under the traffic demand mix, and the **Traffic demand mix - General** tab appears.

3. In the **Traffic demand mix - General** tab, enter a suitable name, optionally a description and click **Apply**. The result looks as in the following example:



4. To configure the newly created traffic demand, proceed with Step 3 in Define WiMAX Traffic Demand.
5. To add traffic demands to the mix, proceed with Define WiMAX Traffic Demand.

Fields on Window "Traffic Demand Mix"

Field	Description
Name	Name of the traffic demand mix. Maximum 128 alphabetical or numerical characters. Do not use / ,\,' or %.
Description	Description of the traffic demand mix

Define WiMAX Traffic Demand

A traffic demand models the traffic load contribution from the terminal types using the same bearer. See also Traffic Density and Traffic Demand on page 7-24.

Prerequisites

- The terminal types to include in the terminal distribution of the traffic demand must be defined, see WiMAX Terminal Types on page 8-4.
- If the traffic demand is non-uniform, a traffic density map valid for the bearer must be defined, see *Define Traffic Density Maps* in the *TEMS CellPlanner Common Features User's Guide*.

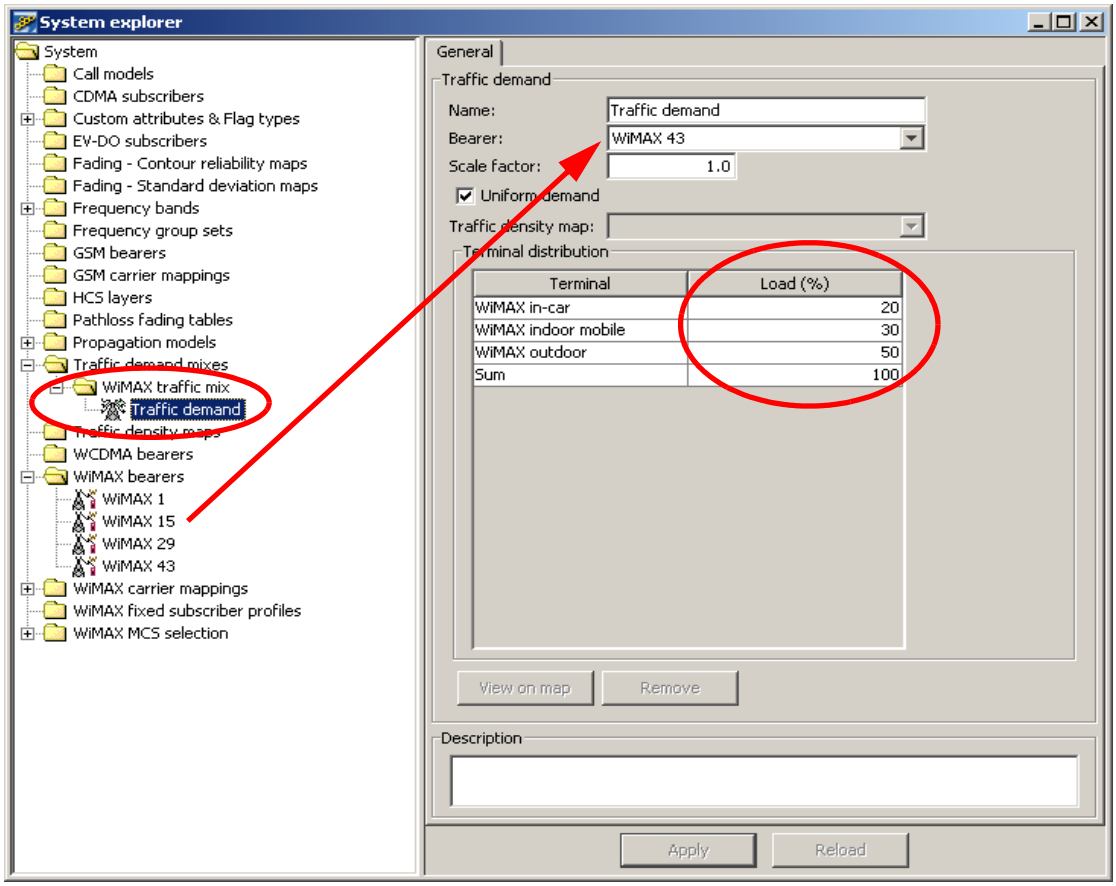
Procedure

Follow the steps below to define a WiMAX traffic demand of a specific bearer. In this example, the traffic demand is uniform:

1. Select **Utilities↗System explorer.**
2. To create a new traffic demand, right-click the **Traffic Demand mix** folder, and select **Add Traffic demand** from the menu. The **Traffic demand** window is displayed.
3. Select a bearer. The terminal types associated with that bearer appears in the **Terminal distribution** list.
4. If the traffic is uniform, select the **Uniform demand** option.

   If the traffic is non-uniform, clear the **Uniform demand** option and select a **Traffic density map**. (Not shown in the example below)
5. Set **Scale factor** to a suitable value.
6. Define a terminal distribution by setting the **Load** values per terminal type. The sum of the load values must add up to 100%.

7. The result looks as in the following example:



8. Click **Apply** to preserve the settings of the traffic demand.

Fields on Window "Traffic Demand"

Field	Description
Name	Name of the traffic demand. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Bearer	The bearer for the traffic demand. Unsymmetrical load, that is, different load in DL and UL, is defined by configuring different DL and UL bitrates in the bearer. See Define WiMAX Bearers on page 7-16.
Scale factor	For uniform demand, this parameters is a direct demand value in users/km^2. For non-uniform (land use category dependent) demand, this parameter is a pure scale factor expressed in users. The scale factor is multiplied with each factor in the traffic density map, then with 1/km^2 per bin.

Field	Description
Uniform demand	Selects uniform traffic demand. When you select this option, you cannot select a traffic density map. The choice affects the unit of the scale factor.
Traffic density map	Traffic density map to use with this traffic demand. If you select a traffic density map, you cannot select uniform demand for this traffic demand.
Terminal distribution	A list of all terminals with a traffic load contribution from each terminal. The list shows all terminals associated with the selected WiMAX bearer. Set the terminal distribution such that the sum is 100%.
View on map	Displays the terminal distribution in the map display
Remove	Deletes a terminal from the distribution
Description	Description of the traffic demand.

WiMAX Fixed Subscriber Profiles

A WiMAX fixed subscriber profile includes a terminal complying to the IEEE 802.16d (2004) standard, an antenna type and the average traffic load for subscribers using this profile.

The fixed subscriber profile is included in the definition of the fixed subscriber, and further used in the WiMAX Fixed Subscriber Analysis.

The terminal of a fixed subscriber is either non-mobile or nomadic, which means that it can be connected to different WiMAX cells at different times, but handover during a call is not possible. Examples of terminal types for a fixed subscriber profile are indoor, window or roof-top mounted. Read more about WiMAX fixed subscribers in Add WiMAX Fixed Subscribers on page 10-16.

Define WiMAX Fixed Subscriber Profile

Use this procedure to define profiles for WiMAX fixed subscribers or to modify imported or already defined profiles.

Prerequisites

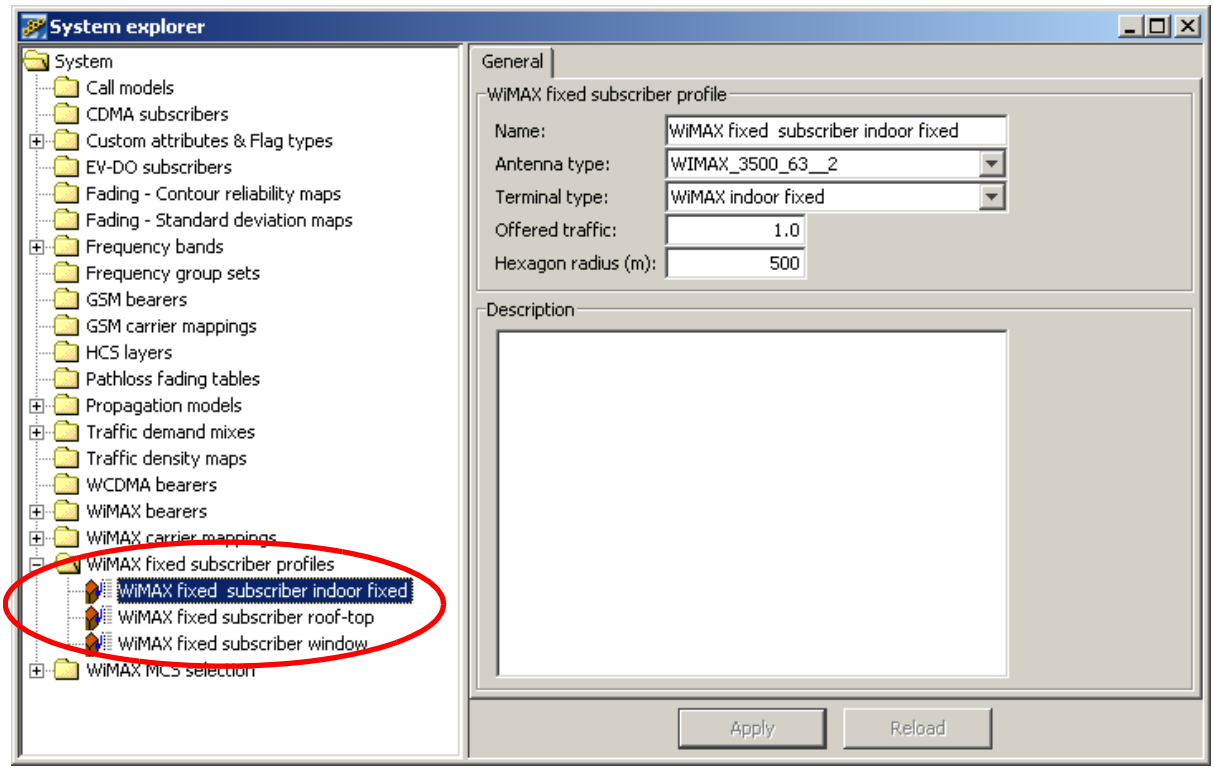
- The antenna type is defined, see Antenna Types on page 8-3.
- The terminal type is defined, see WiMAX Terminal Types on page 8-4.
- The bearer is defined, see Define WiMAX Bearers on page 7-16.

Procedure

Follow these steps to define a WiMAX subscriber profile:

1. Select **Utilities↗System explorer.**
2. Right-click the **WiMAX fixed subscriber profiles** folder and select **Add WiMAX fixed subscriber profile**. The **WiMAX subscriber profile** window appears.
3. Enter a suitable name for the traffic demand.
4. Select an antenna type.
5. Select a terminal type.
6. Modify the other parameters as required.

7. The result looks as in the following example:



8. Click Apply to preserve the fixed subscriber profile.

Fields on Window "WiMAX Fixed Subscriber Profile"

Field	Description
Name	Name of the subscriber profile. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Antenna type	Type of antenna for the profile, selected from a list of imported antennas
Terminal type	Type of terminal for the profile, selected from a list of defined WiMAX terminals
Offered traffic	Average number of active calls for the supported bearer. Range: 0 - 1000. Default = 1.
Hexagon radius (m)	Hexagon radius in meters used when creating nominal site. Range: 0 - 100000. Default = 500.
Description	Description of the WiMAX fixed subscriber profile

Custom Attributes and Flag Types

Some objects in your project can be tagged with your own text or graphical attributes to be shown in the plots.

The following WiMAX custom attributes are predefined in the System Explorer:

- WiMAX RBS attributes
- WiMAX cell attributes
- WiMAX fixed subscriber attributes

See C*ustomizing Attributes for Sites, RBSs and Cells* in the *TEMS CellPlanner Common Features User's Guide*.

8
WiMAX Equipment Types

This chapter describes how to define the equipment types of a WiMAX network.

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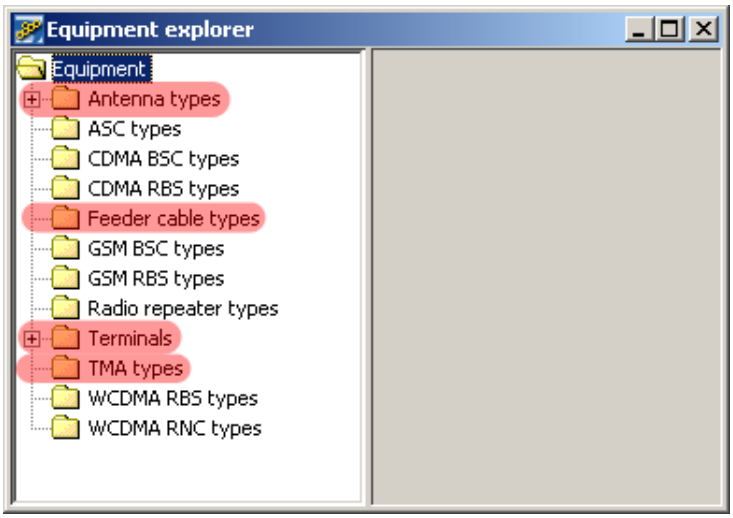
Antenna Types. 8-3
TMA Types (Optional) 8-3
Feeder Cable Types (Optional) 8-3
WiMAX Terminal Types 8-4
Suggested WiMAX Terminal Types 8-4
Define WiMAX Terminal Types 8-5

About WiMAX Equipment Types

Before adding sites and cells with physical *equipment* to your network project, you need to define the *equipment types* to be used. The equipment types include data about vendor, product id and so on.

You can add or delete equipment types using the right-click mouse menus in the **Equipment explorer**. In the figure below, the equipment types relevant for WiMAX are highlighted:



The standard flow of planning equipment types in a WiMAX network with TEMS CellPlanner is reflected in the order of procedures in this chapter and in the list below:

1. Antenna types
2. TMA types (optional)
3. Feeder cable types (optional)
4. WiMAX terminal types

The WiMAX specific equipment types, marked with bold in the list above, are described with procedures in this manual. The equipment types common for several technologies are described in the *TEMS CellPlanner Common Features User's Guide*.

The actual addition of *equipment* based on these *equipment types* is described in WiMAX Sites, RBSs, Cells and Fixed Subscribers on page 10-1.

Antenna Types

You can define the WiMAX antenna types either manually or by import from antenna files.

The recommended method is to import pre-defined antenna types, see *Import EET/Planet 2.x Antennas* in the *TEMS CellPlanner Common Features User's Guide*.

If you prefer defining the antennas manually, follow the instructions in the *TEMS CellPlanner Common Features User's Guide*, chapters:

- Define Antenna Types
- Specify Antenna Bands
- Define Antenna Lobes
- Define Antenna Horizontal Patterns
- Define Antenna Vertical Patterns

TMA Types (Optional)

See *Define TMA Types* in the *TEMS CellPlanner Common Features User's Guide*.

Feeder Cable Types (Optional)

See *Define Feeder Cable Types* in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX Terminal Types

To get accurate WiMAX Analysis results you need to define the most common mobile terminal (MS) types and fixed subscriber terminal (SS) types expected in your radio network. You define those devices as *Terminals* in the Equipment explorer.

The capabilities of the terminal types are, as part of selected traffic cases, considered in analysis functions. Read more on this topic in About Traffic Cases in WiMAX Analysis on page 14-2.

Multi-Carrier or Single-Carrier Terminal

For fixed subscriber terminals in a network with multi-carrier WiMAX RBSs, a multi-bearer configuration using several carrier frequencies is recommended. See About WiMAX Fixed Subscribers on page 14-10 and example in Figure 8–1.

For all other cases it is recommended to add a single bearer, as in Figure 8–2.

The WiMAX Fixed Subscriber Analysis is capable of analyzing multiple frequencies, while the WiMAX Best Server Analysis is limited to analyze one frequency at a time.

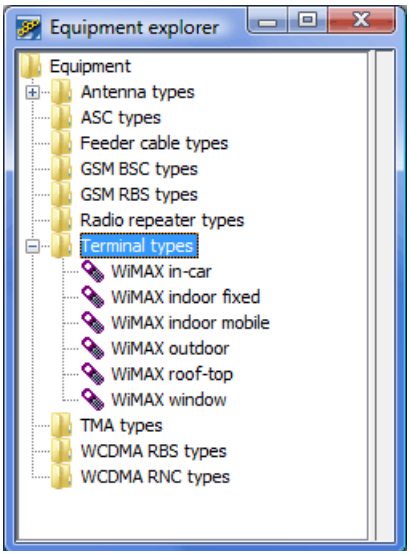
Suggested WiMAX Terminal Types

The following terminal types are suggested for a WiMAX project:

Mobile terminals (MS):
- indoor mobile
- in-car
- outdoor

Fixed subscriber terminals (SS):
- indoor fixed
- roof-top
- window

The figure below shows an example snapshot from the Equipment explorer:



Define WiMAX Terminal Types

A terminal type is characterized by its antenna height, gain and loss. A WiMAX terminal type is also defined by its diversity gain, Rx and Tx loss, supported bearers and MCS in UL and DL. You must set these parameters to give correct input to the analysis calculations.

Prerequisites

- Get information about the most common WiMAX terminal types to consider in analysis of the network. For a typical mix of terminals, see Suggested WiMAX Terminal Types on page 8-4.
- The MCS selections to use for DL and UL are defined, see Define WiMAX MCS Selection on page 7-19.
- The WiMAX bearers to be supported by the terminal type are defined, see Define WiMAX Bearers on page 7-16

Procedure

1. From the **Utilities** menu, click **Equipment explorer**.
2. From the left-hand browser window, right-click the **Terminal types** folder and select **Add Terminal** type. The **Terminal types - General** tab panel appears.
3. Assign the general parameters, see Fields on Window "Terminal types - General".
4. Select the **WiMAX support** option. A dialog window asking you for a WiMAX MCS selection is opened.

5. Select an MCS selection and click **OK**. The dialog disappears and the WiMAX tab becomes enabled in the General window.
6. Assign the WiMAX parameters, see Fields on Window "Terminal types - WiMAX" on page 8-7
7. Click **Apply** to preserve the settings. The result might look as in the following examples:

Figure 8–1 Definition of a fixed subscriber terminal with three bearers

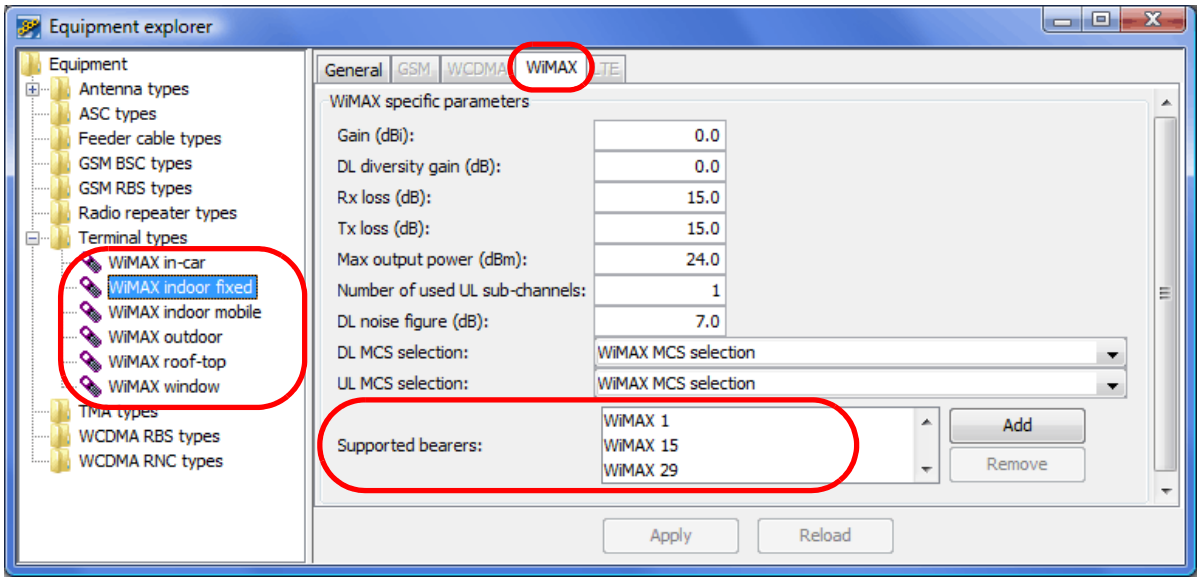
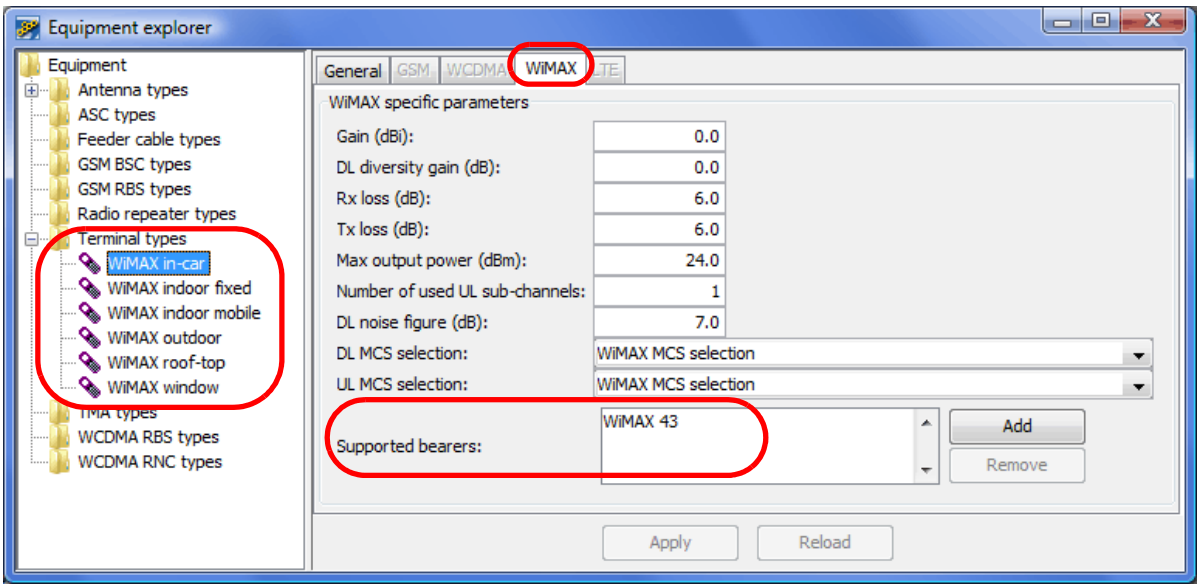


Figure 8–2 Definition of a mobile terminal with one bearer



Fields on Window "Terminal types - General"

Field	Description
Name	Name of the terminal type. The name of the terminal will appear in the left-hand browser window. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %. Suggestion: Assign an easily recognized name, for example including the terminal's brand and capabilities.
Antenna height	Height of terminal antenna, above ground level. Range 0 - 100. Default = 1.5 m. ***Note:*** *The antenna height defined here is relevant only for mobile terminals. For a fixed subscriber, this value is overridden by the height configured for that fixed subscriber, see* Add WiMAX Fixed Subscribers *on page 10-16.*
GSM support WCDMA support WiMAX support LTE support	Indicates the radio technologies supported by the terminal. Selecting an option enables the corresponding tab.
Description	Description of the terminal type (optional).

Fields on Window "Terminal types - WiMAX"

Field	Description
Gain (dBi)	Antenna gain. Range: 0 - 100. Default = 0. ***Note:*** *The gain value of the terminal type is used for mobile subscribers only. For a fixed subscriber, this value is overridden by the gain of its antenna type.*
DL diversity gain (dB)	Range: 0 - 10. Default = 0.
Rx loss (dB)	The sum of rx losses such as body loss, building penetration loss, and feeder loss from an external terminal antenna. Range 0 - 50. Default = 0 dB.
Tx loss (dB)	Range: 0 - 50. Default = 0.
Max output power (dBm)	The maximum transmit power of the terminal. Range: 0 - 40. Default = 24.
Number of used UL sub-channels	Range: 1 - 10000. Default = 1.
DL noise figure (dB)	Range: 0 - 40. Default = 7.
DL WiMAX MCS selection	MCSs to be used for DL, selected from a set defined in the System explorer.
UL WiMAX MCS selection	MCSs to be used for UL, selected from a set defined in the System explorer.

Field	Description
Supported bearers	Bearers supported by this terminal type. Each bearer is associated with a carrier. The WiMAX bearers are defined in the System explorer. See Multi-Carrier or Single-Carrier Terminal on page 8-4 for recommendations on how many bearers to add as supported for a certain terminal.
Add	Adds a bearer to the list of supported bearers
Remove	Removes a selected bearer from the list of supported bearers

9
WiMAX Templates

This chapter describes how to define the templates of a WiMAX network plan.

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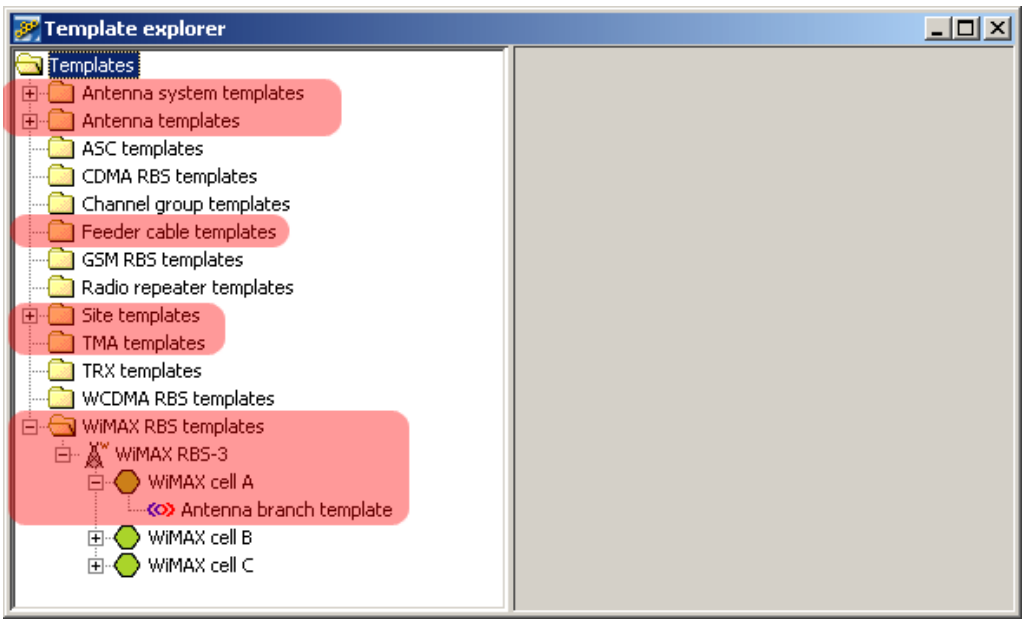
About WiMAX Templates

You can save time by using templates when you build your network plan. The templates define default parameter values to be inherited by network elements defined after definition of the templates.

Note: *Changes in templates do not affect already created network elements based on templates.*

You can add or delete templates using the right-click mouse menus in the **Template explorer**. In the figure below, the top level templates relevant for WiMAX are highlighted:



The standard work flow of defining WiMAX templates with TEMS CellPlanner is reflected in the order of procedures in this chapter and in the list below:

1. Antenna template
2. TMA template (optional)
3. Feeder cable template (optional)
4. Antenna system template
5. WiMAX RBS template
6. WiMAX cell template
7. WiMAX antenna branch template
8. WiMAX RBS site template
9. WiMAX fixed subscriber site template

The WiMAX specific templates, marked with bold in the list above, are described in this manual. The templates common for WiMAX and other technologies are described in the *TEMS CellPlanner Common Features User's Guide*.

Example: How to Organize WiMAX Templates

A suggested method is to organize WiMAX templates for the WiMAX network plan. The following example describes templates for a three-sector RBS:

Templates	Recommended Template Configurations
Define three antenna templates	Name them: • "WiMAX A" • "WiMAX B" • "WiMAX C" Set different azimuths in each template, for example 0, 120, 240 (or other appropriate azimuth angles). Antenna types must be imported.
Define antenna system template	Name it "WiMAX antenna system", and add the three imported antennas
Define a WiMAX RBS template	Name it "WiMAX RBS template"
Define a WiMAX cell template	Name it "WiMAX cell template"
Define three antenna branch templates	For each antenna branch template, include the appropriate antenna. An antenna branch template may be defined for a cable repeater antenna branch. You must then select the cable repeater option.
Define a WiMAX RBS site template	Name it "WiMAX RBS site template" and include the WiMAX RBS template
Define a WiMAX fixed subscriber template	Name it "WiMAX fixed subscriber template"

You may create several templates in the same way, using different frequency bands and antennas. In each template, enter appropriate parameter values.

Antenna Equipment Templates

Antenna Templates

See *Define Antenna Templates* in the *TEMS CellPlanner Common Features User's Guide*.

TMA Templates (Optional)

See *Define TMA Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Note: *TMAs can be part of WiMAX antenna systems, while ASCs are relevant for WCDMA antenna systems only.*

Feeder Cable Templates (Optional)

See *Define Feeder Cable Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Antenna System Templates

The antenna system template is a container of sets of the following templates:

- Antenna template
- TMA template (optional)
- Feeder cable template (optional)

You thus need to define the above templates before defining an antenna system template.

One antenna system template can include a multiple number of each of the templates above, for example three antenna templates and two TMA templates. The final selection of which one of each template to use is done per antenna branch, see Define WiMAX Antenna Branch Template on page 9-10.

See *Define Antenna System Templates* in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX RBS and Cell Templates

You can save time by using templates for WiMAX RBSs and cells in a WiMAX network plan including:

- many RBSs with the same type of antenna equipment and cell configuration
- many cells with the same cell parameters and antenna branch settings

Define WiMAX RBS Template

A WiMAX RBS template includes an antenna system template and optional custom attributes.

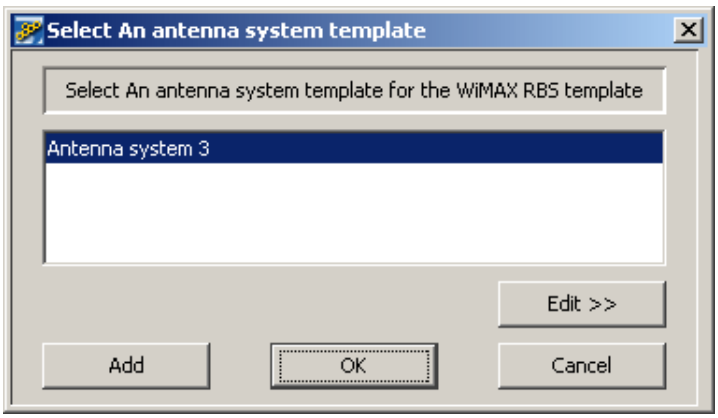
A WiMAX RBS template hosts one or more WiMAX cell templates, each hosting one or more antenna branch templates.

Prerequisites

The Antenna System Template to use is defined, see Antenna System Templates on page 9-4.

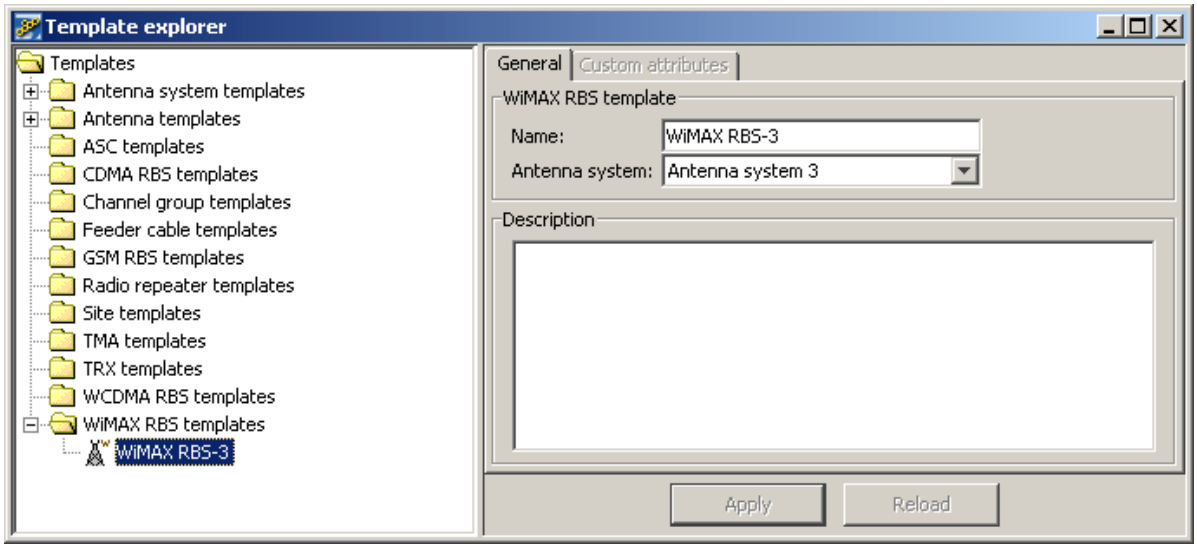
Procedure

1. Select **Utilities↗Template explorer**, and highlight the **WiMAX RBS template** folder.
2. Right-click the folder, and select **Add WiMAX RBS template**. A dialog asking you to select an antenna system appears:



3. Select an antenna system from the list and click **OK**. The **WiMAX RBS template** window is displayed.
4. Enter the name of the WiMAX RBS template.
5. Optionally, enter a description of the WiMAX RBS template.

6. If you have defined custom attributes for WiMAX RBS, you can select flag values for the WiMAX RBS template under the **Custom attributes** tab.
7. Click **Apply** to preserve the WiMAX RBS template. The result looks as in the following example:



8. Proceed with Define WiMAX Cell Template on page 9-6.

Fields on Window "WiMAX RBS Template - General"

Field	Description
Name	Name of the WiMAX RBS. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Antenna system	Antenna system selected for the WiMAX RBS template
Description	Description of the WiMAX RBS template

Define WiMAX Cell Template

A WiMAX cell template is a sub-template of a WiMAX RBS template.

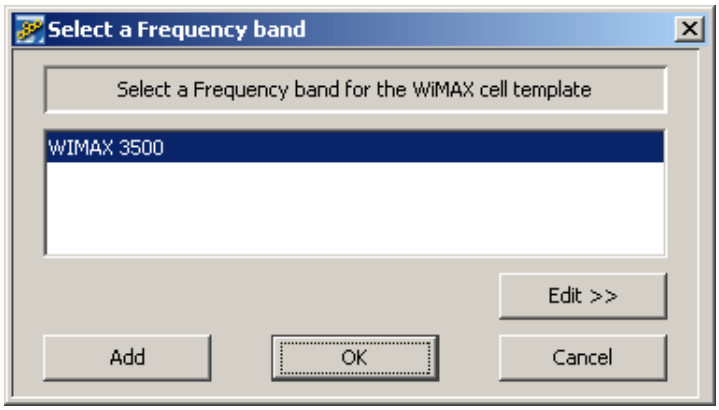
The WiMAX cell template defines among other the frequency band and the radio to use, and hosts one or more antenna branch templates.

Prerequisites

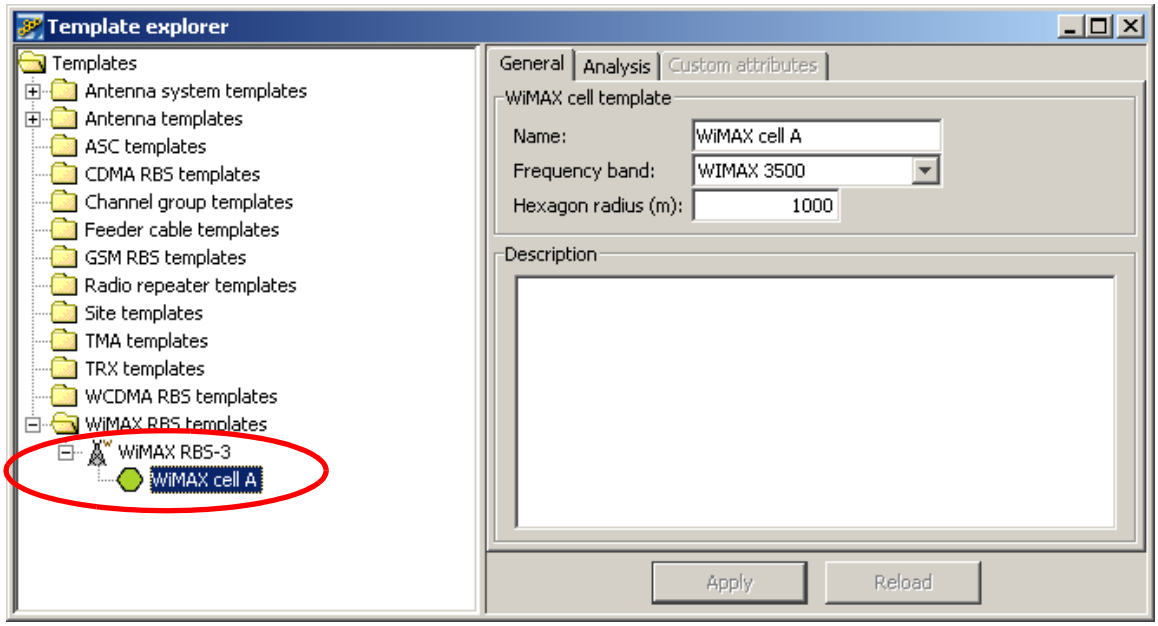
- The WiMAX RBS template to host the cell template is defined, see Define WiMAX RBS Template on page 9-5
- The frequency band to use is defined, see Define WIMAX Frequency Band on page 7-7.

Procedure

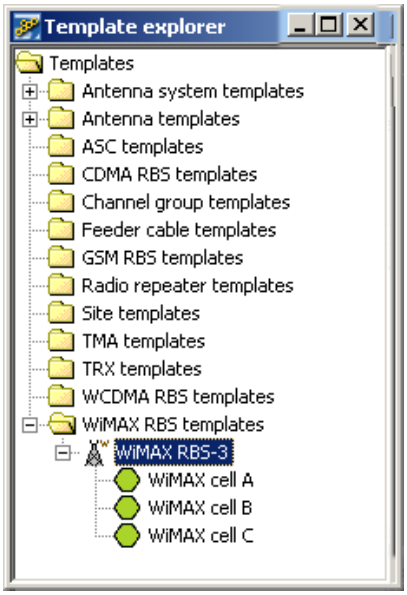
1. Select **Utilities↗Template explorer**, and highlight a WiMAX RBS template.
2. Right-click the WiMAX RBS template, and select **Add WiMAX cell template**. A window requesting you to select a frequency band appears:



3. Select a frequency band from the list and click **OK**. The window of the **General** tab appears.
4. Enter a name of the WiMAX cell template.
5. Modify the hexagon radius if required.
6. The result may look as in the following example:



7. Modify the cell parameters to be used for analysis if required. See Configure WiMAX Cell Template Analysis Parameters on page 9-8.
8. Repeat the procedure for all cell templates to define. In the example below, three WiMAX cell templates are defined for a WiMAX RBS template:



9. Proceed with Define WiMAX Antenna Branch Template on page 9-10.

Fields on Window "WiMAX Cell Template"

Field	Description
Name	Name of the WiMAX cell template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Frequency band	The frequency band used for the cell.
Hexagon radius (m)	The hexagon radius when displaying the cell as a hexagon on the map. Range: 1 - 100000. Default = 1000.
Description	Description of the WiMAX cell template

Configure WiMAX Cell Template Analysis Parameters

Use this procedure to modify the analysis parameters of a WiMAX cell template.

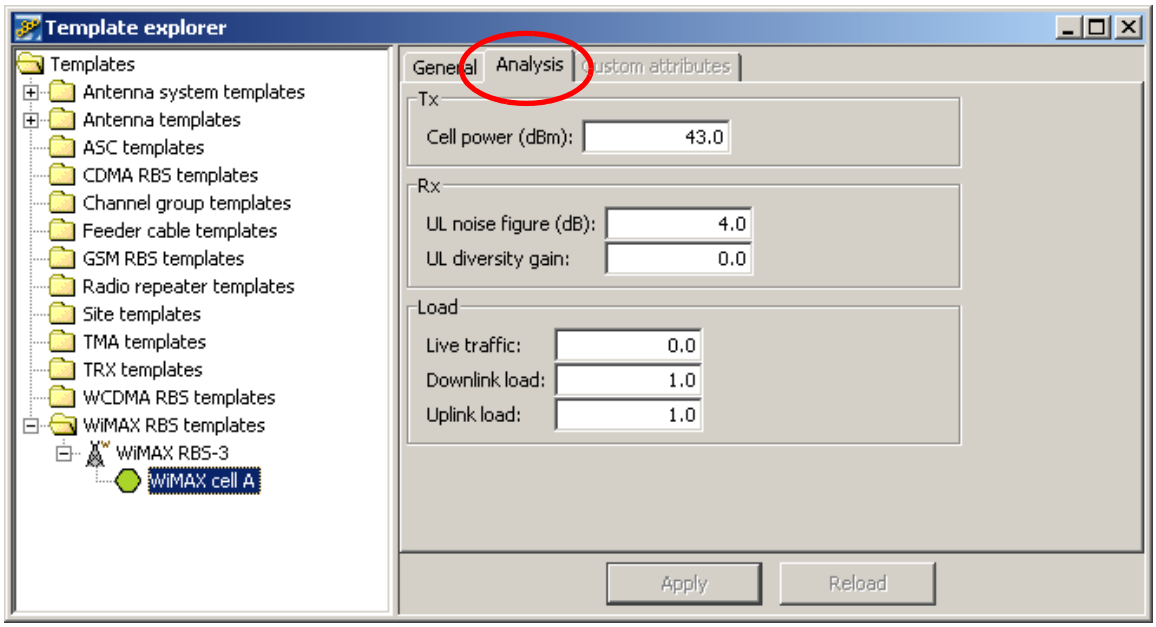
Prerequisites

- The WiMAX cell template is defined, see Define WiMAX Cell Template on page 9-6.

Procedure

Follow the steps below to modify the WiMAX cell template analysis parameters:

1. Select **Utilities↗Template explorer** and select the cell template to modify, located under **WiMAX RBS templates**. The **WiMAX cell template** window appears.
2. Select the **Analysis** tab. The **Analysis** window appears:



3. Modify Tx, Rx and Load parameters as required.
4. Click **Apply** to preserve the settings.

Fields on Window "WiMAX Cell Template Analysis"

Field	Description
Tx Cell power (dBm)	Frequency output power. Range: 0 - 60. Default = 43 dBm.
Rx UL noise figure (dB)	The ratio of the self-noise to the thermal noise level. Range: 0-15. Default = 4 dB.
Rx UL diversity gain	Gain in dB due to spatial antenna diversity added to the received signal. Range: 0 - 10. Default = 0.
Live traffic	Number of terminals. Default = 0.
Downlink load	Downlink load on cell. Calculated in traffic analysis. Range: 0 - 1. Default: 1.
Uplink load	Uplink load on cell. Calculated in traffic analysis. Range: 0 - 1. Default: 1.

WiMAX Antenna Branch Templates

WiMAX antenna branch templates save you time when your WiMAX network plan includes many sites with the same propagation model and antenna equipment.

About Antenna Branches

A WiMAX antenna branch is part of a WiMAX cell. It defines among other the propagation models and the antenna type, feeder cable and TMA to use.

Define WiMAX Antenna Branch Template

Use this procedure to define antenna branch templates of a WiMAX cell.

If you need antenna branches for normal antennas and for cable repeaters, define a separate antenna branch template for the cable repeater.

Prerequisites

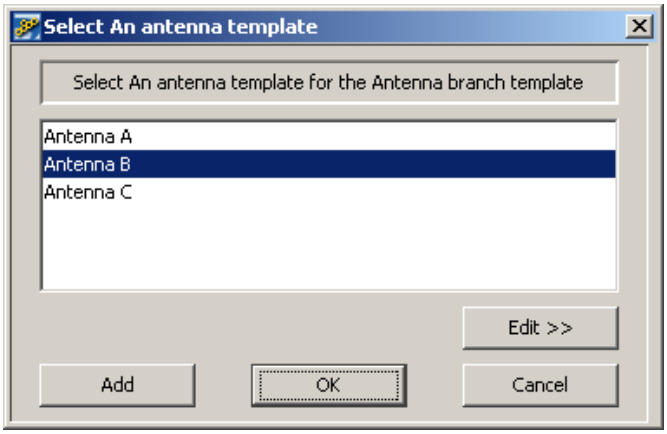
- The WiMAX cell template to host the antenna branch template is defined, see Define WiMAX Cell Template on page 9-6.
- The propagation models are defined, see WiMAX Propagation Models on page 7-22. You need one propagation model for mobile subscribers and one point-to-point propagation model for fixed subscribers.
- The antenna template is defined, see Antenna Templates on page 9-4.

Procedure

To define an antenna branch templates for a WiMAX cell, follow these steps:

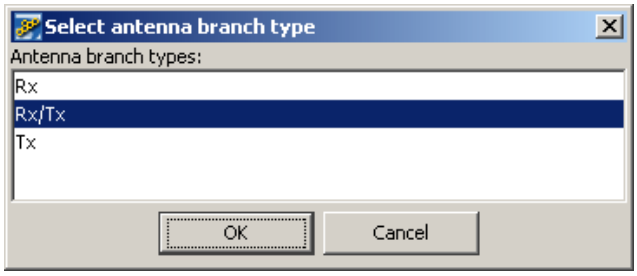
1. Select **Utilities↗Template explorer**, and locate the WiMAX cell template in the **WiMAX RBS template** folder.
2. Right-click the WiMAX cell, and select **Add Antenna branch template**.

A dialog requesting you to select an antenna template appears:



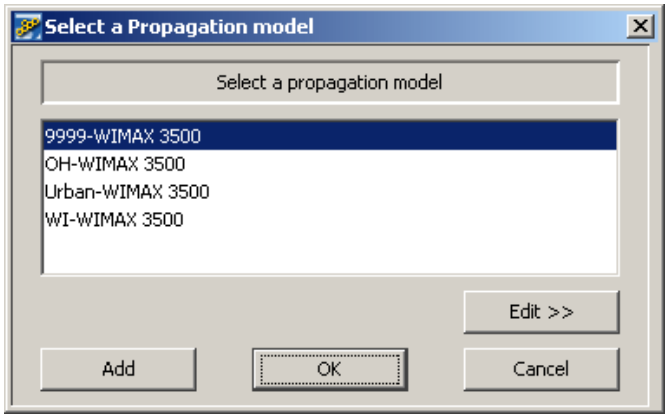
3. Select an antenna template from the list and click **OK**.

   The **Select antenna branch type** appears:



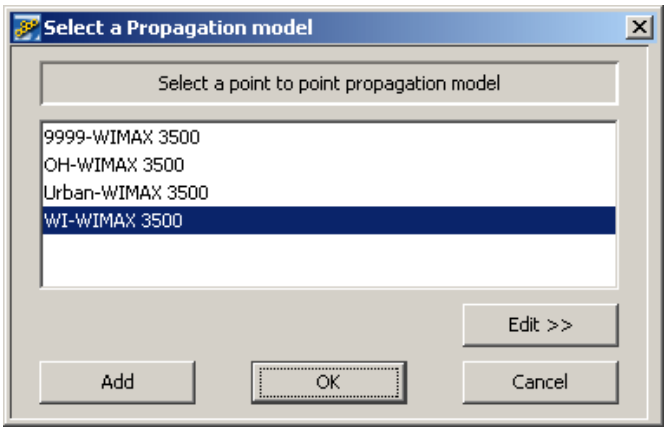
4. Select to use the antenna branch for duplex Rx/Tx, Rx only or Tx only and click **OK**.

   The **Select a propagation model** window appears:



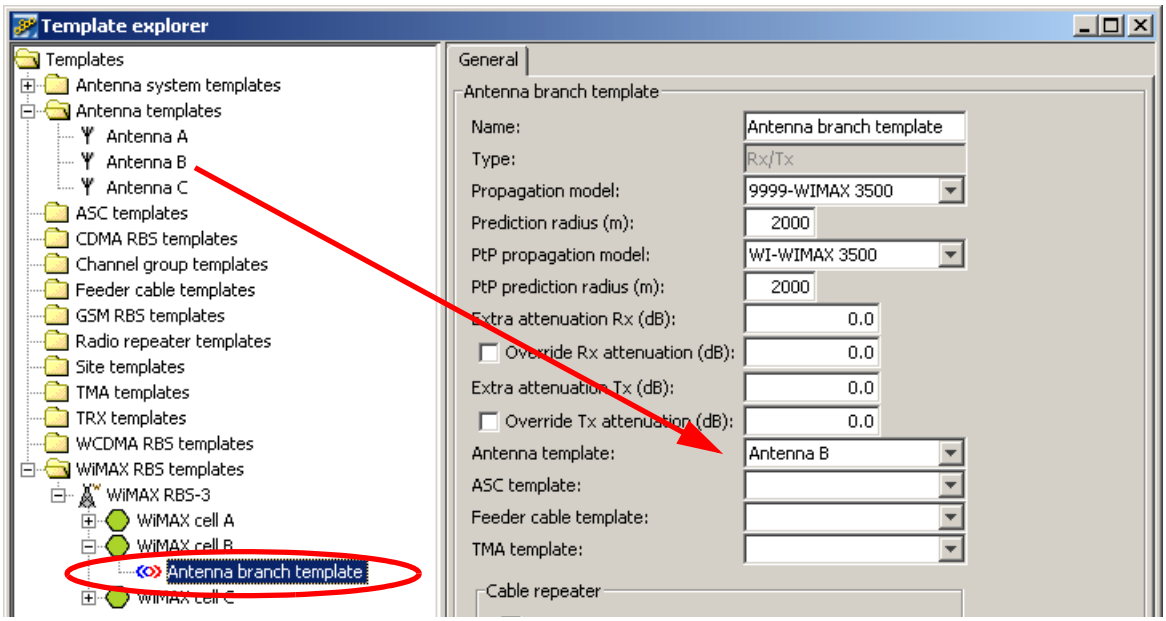
5. Select the propagation model to be used for mobile terminals and click **OK.**

The window **Select a point to point propagation model** appears:



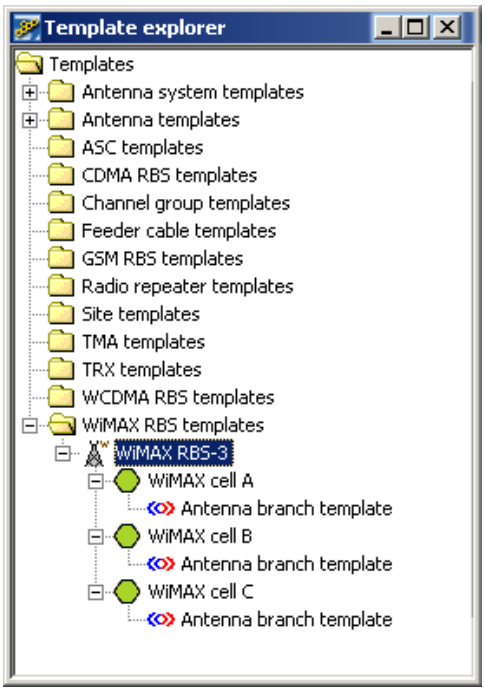
6. Select a point to point propagation model to be used for fixed subscribers and click **OK**.

   The antenna branch is created under the WiMAX cell and the **Antenna branch template** window appears:



7. Select feeder cable template and TMA template, if applicable.
8. Change the other parameters as required.
9. Click **Apply** to preserve the antenna branch template of the cell.
10. Repeat the procedure for all cell templates without an antenna branch template.

The result may look as in the following example:



Fields on Window "Antenna Branch Template"

Field	Description
Name	Name of the antenna branch template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Type	Transmission/reception type of the antenna branch
Propagation model	Propagation model for the cell, selected from a list of defined models
Prediction radius (m)	The maximum distance from the site to the point of prediction. Range: 0 - 200000. Default = 2000.
PtP propagation model	Propagation model for the cell, selected from a list of defined models. Range: 0 - 100000. Default = 2000.
PtP prediction radius (m)	The maximum distance from the site to the point of prediction
Extra attenuation Rx (dB)	Extra UL loss value in decibels, added to the calculated *Total Rx attenuation* in the antenna branch using this template. Range 0 - 50. Default = 0.
Override Rx attenuation (dB)	If selected, the associated attenuation value overrides the *Total Rx attenuation* in the antenna branch using this template. Range: 0 - 100. Default = 0.

Field	Description
Extra attenuation Tx (dB)	Extra DL loss value in decibels, added to the calculated *Total Tx attenuation* in the antenna branch using this template. Range 0 - 50. Default = 0.
Override Tx attenuation (dB)	If selected, the associated attenuation value overrides the *Total Tx attenuation* in the antenna branch using this template. Range: 0 - 100. Default = 0.
Antenna template	Antenna template associated with the antenna branch
ASC template	Antenna system controller (ASC) template. Not used in WiMAX network plans.
Feeder cable template	Feeder cable template, if applicable.
TMA template	Tower mounted antenna (TMA) template, if applicable.
Cable repeater:	
Cable repeater	Enables use of the cable repeater parameters. If selected: • the Tx power parameter of the cell created from this template inherits the cable repeater power instead of the cell Tx power • you should give the antenna branch a name clearly showing it is a cable repeater antenna branch
Max. repeater power (dBm)	Cable repeater transmitted power. Range -40.0 - 80.0 dBm. Default = 20 dBm.
Description	Description of the antenna branch template

Site Templates

Site templates save you time when you have many sites using the same type of antenna systems, RBSs and site attributes in your network plan.

In a WiMAX network plan, you can define two different site types, with their own templates:

- WiMAX RBS site hosting WiMAX cells with antenna branches
- WiMAX fixed subscriber hosting non-mobile WiMAX terminals

Read more about site templates in *Define Site Templates* in the *TEMS CellPlanner Common Features User's Guide*.

Define WiMAX RBS Site Template

Use this procedure to define a template for a WiMAX RBS site.

Prerequisites

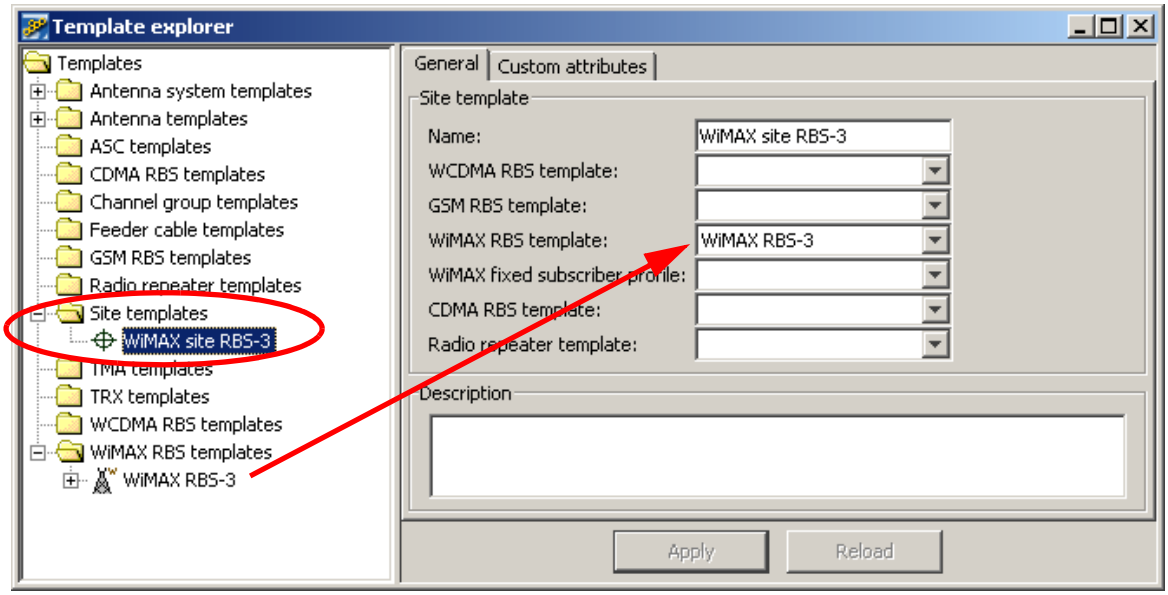
At least one WiMAX RBS template is defined, see Define WiMAX RBS Template on page 9-5.

Procedure

To define a WiMAX RBS site template, follow these steps:

1. Select **Utilities↗Template explorer**.
2. Right-click on **Site templates**, and select **Add site template**.
3. Enter a descriptive name of the template.
4. Select a WiMAX RBS template.
5. If you have defined custom attributes for site, you can select flag values for the WiMAX site template under the **Custom attributes** tab.

6. Click **Apply** to preserve the WiMAX RBS site template. The result may look as in the following example:



Fields on Window "Site Template"

The following fields are relevant for WiMAX:

Field	Description
Name	Name of the site template. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
WiMAX RBS template	Selected from list of WiMAX RBS templates. Used only for site templates of WiMAX RBSs.
WiMAX fixed subscriber profile	Selected from list of WiMAX subscriber profiles. Used only for site templates of fixed subscribers.
Description	Description of the template

Define WiMAX Fixed Subscriber Site Template

Use this procedure to define a template for a WiMAX fixed subscriber.

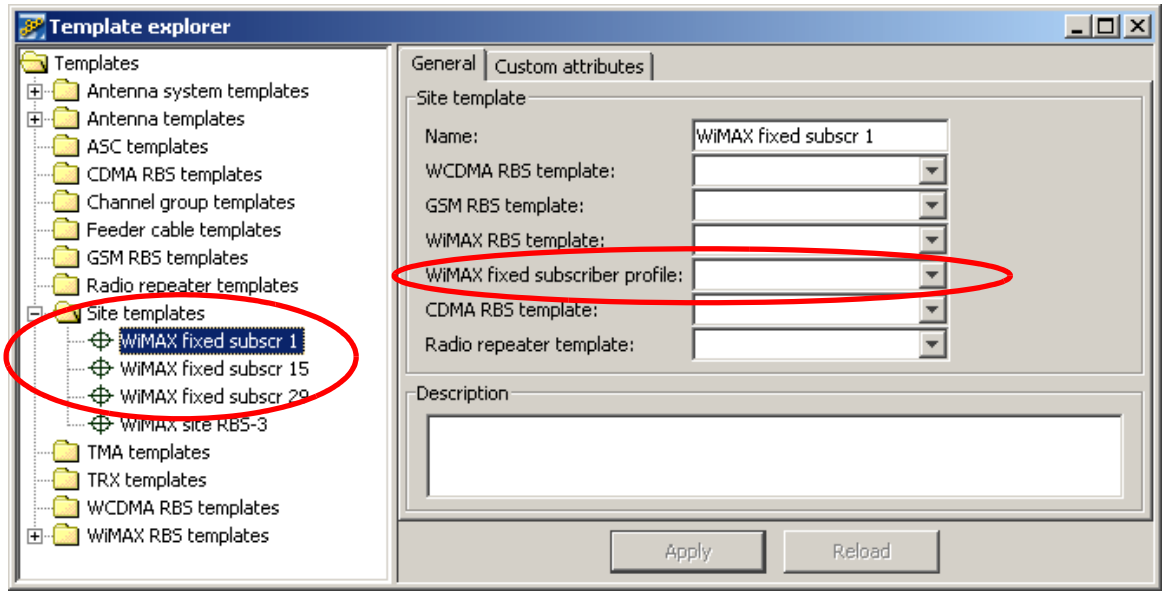
Prerequisites

At least one WiMAX fixed subscriber profile is defined, see Define WiMAX Fixed Subscriber Profile on page 7-29.

Procedure

To define a WiMAX fixed subscriber site template, follow these steps:

1. Select **Utilities↗Template explorer**.
2. Right-click on **Site templates**, and select **Add site template**.
3. Enter a descriptive name of the template.
4. Optionally, select a WiMAX fixed subscriber profile.
5. Click **Apply** to preserve the WiMAX fixed subscriber template. The result may look as in the following example:



Fields on the Window

See Fields on Window "Site Template" on page 9-16.

10
WiMAX Sites, RBSs, Cells and Fixed Subscribers

This chapter describes how to define the sites with their network elements: WiMAX RBSs with cells and antenna branches, and WiMAX fixed subscribers, in a WiMAX network plan.

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Add WiMAX Sites 10-3
WiMAX RBS Sites 10-4
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Add WiMAX RBS to a Site (Add Without Template) 10-7
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Antenna Systems 10-19
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WiMAX Sites

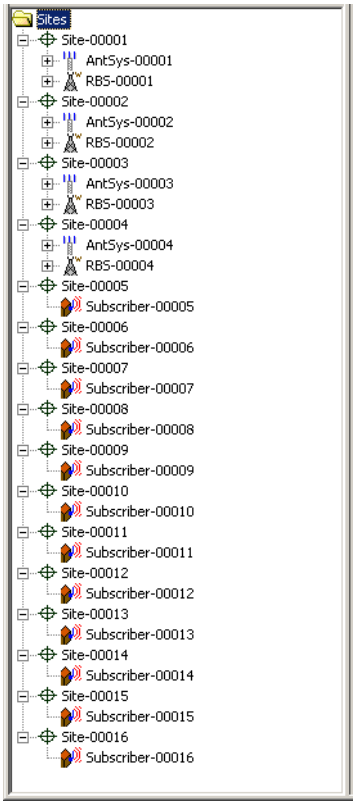
A site is defined by its position (longitude and latitude) and antenna height.

There are two different types of sites in a WiMAX network plan:

- WiMAX RBS sites with WiMAX RBSs, cells and antenna branches, accompanied by an antenna system
- WiMAX fixed subscriber sites, the TEMS CellPlanner name of non-mobile terminals. Fixed subscribers are modeled as sites as they have fixed positions and use another propagation model than mobile terminals.

The reason for distinguishing between these two types is that the analysis result depends on the mobility and antenna height of the terminal. By modeling fixed subscribers separately, with specific antenna height and point-to-point propagation model, the analysis results become more realistic than if the fixed subscribers were treated as ordinary mobile terminals.

The example below shows a mix of RBS sites and fixed subscriber sites:



You can add, modify and delete sites and their underlying network elements using the **Site explorer**.

Note: *You can also add, modify and delete WiMAX RBSs with underlying network elements using the* ***WiMAX RBS explorer****.*

Read more about sites in chapter *Adding Sites and Determining Site Locations* in the *TEMS CellPlanner Common Features User's Guide*.

Add WiMAX Sites

Add sites by placing them geographically in your network planning area.

Note: *The distance between a WiMAX RBS site and a WiMAX fixed subscriber site should be at least 5 meters, to obtain reliable results in the analysis.*

See *Add Sites* in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX RBS Sites

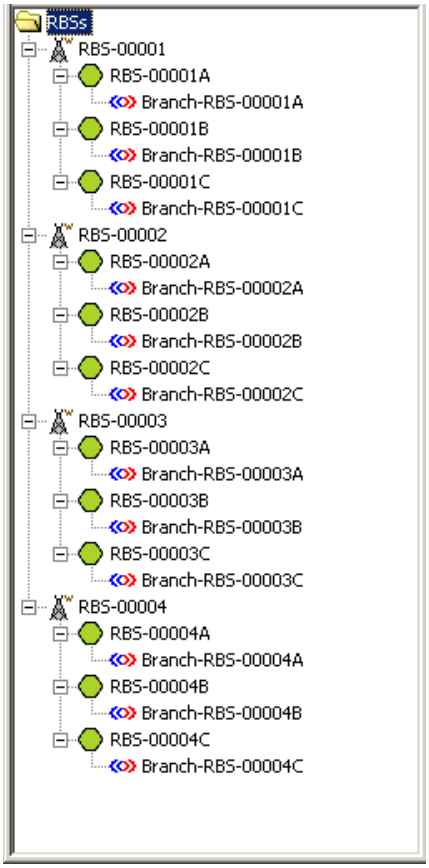
A WiMAX RBS site includes the following network elements:

1. One WiMAX RBS hosting a number of cells with one radio and one antenna branch each
2. One antenna system with antennas, optionally also with feeder cable and TMA

The quickest method to add WiMAX RBS is using a template including cells and an antenna branch, as described in Add WiMAX RBS to a Site (Create From Template). The antenna system is then added automatically, and the second step is not needed.

A more tedious method is to add the WiMAX RBS without using a template, and add an antenna system. The related procedures are described in Add WiMAX RBS to a Site (Add Without Template), Add Antenna System to a Site (Create From Template) and Add Antenna System to a Site (Add Without Template).

You can add, modify and delete sites and their underlying network elements using the **WiMAX RBS explorer**. In the example below, four WiMAX RBSs are defined:



Note: *You can also add, modify and delete WiMAX RBSs with underlying network elements using the* ***Site explorer****.*

Add WiMAX RBS to a Site (Create From Template)

The most efficient way to add a WiMAX RBS to a site is to first create a WiMAX RBS template and add the WiMAX RBS to the site, using this template. The cells with and the antenna branches included in the WiMAX RBS template are added automatically.

The antenna system of the chosen system type is also automatically added to the site when adding the WiMAX RBS from a template, thus no antenna system need to be added to the site in advance.

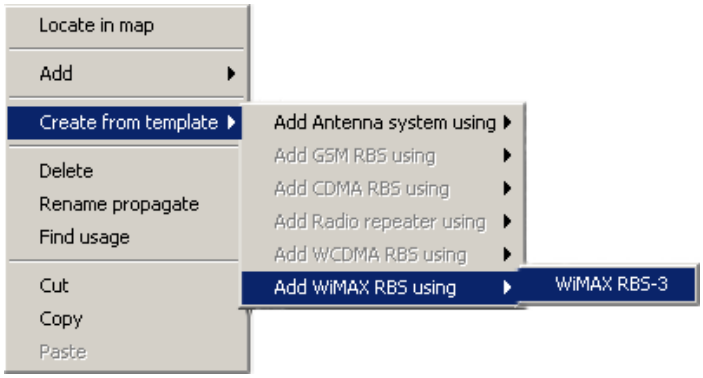
Prerequisites

- The site to host the WiMAX RBS is added, see Add WiMAX Sites on page 10-3.
- The WiMAX RBS template to use is defined, see Define WiMAX RBS Template on page 9-5
- The antenna system template is defined, see Antenna System Templates on page 9-4.

Procedure

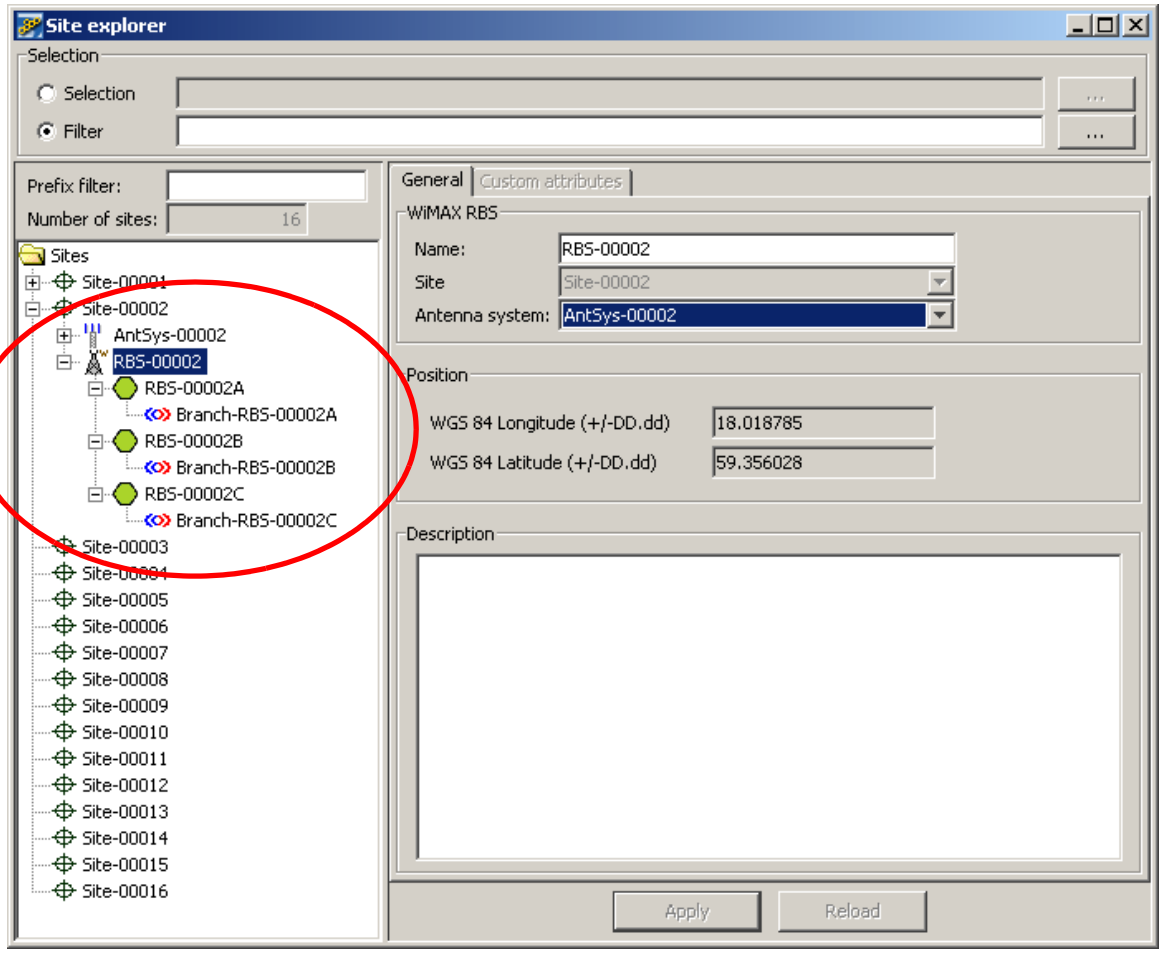
Follow these steps to add a WiMAX RBS and all its network elements to a site:

1. Select **Utilities↗Site explorer. A list of sites is displayed.**
2. Optionally delimit the number of sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Create from template↗Add WiMAX RBS using↗<WiMAX RBS template>, as in the following example:**



4. An antenna system and WiMAX RBS with underlying network elements are created from the template, and appear under the site. The **WiMAX RBS** window appears.
5. Modify the name of the RBS if required.
6. If you have defined custom attributes for WiMAX RBS, you can select flag values for this specific WiMAX RBS under the **Custom attributes** tab.

7. Click **Apply** to preserve the settings. The result looks as in this example:



8. To modify antenna parameters, follow the instructions in Configure Antenna System Parameters on page 10-21.

Fields on Window "WiMAX RBS"

Field	Description
Name	Name of the WiMAX RBS. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Site	The site hosting the WiMAX RBS. Not editable.
Antenna system	Antenna system for the WiMAX RBS, inherited from the template.
Position	The position of the RBS, inherited from the site. Not editable.
Description	Description of the site

Add WiMAX RBS to a Site (Add Without Template)

Instead of using WiMAX RBS template, a WiMAX RBS can be added in a more "raw" way to the site. You then add first the WiMAX RBS and subsequently all its network elements one by one.

Prerequisites

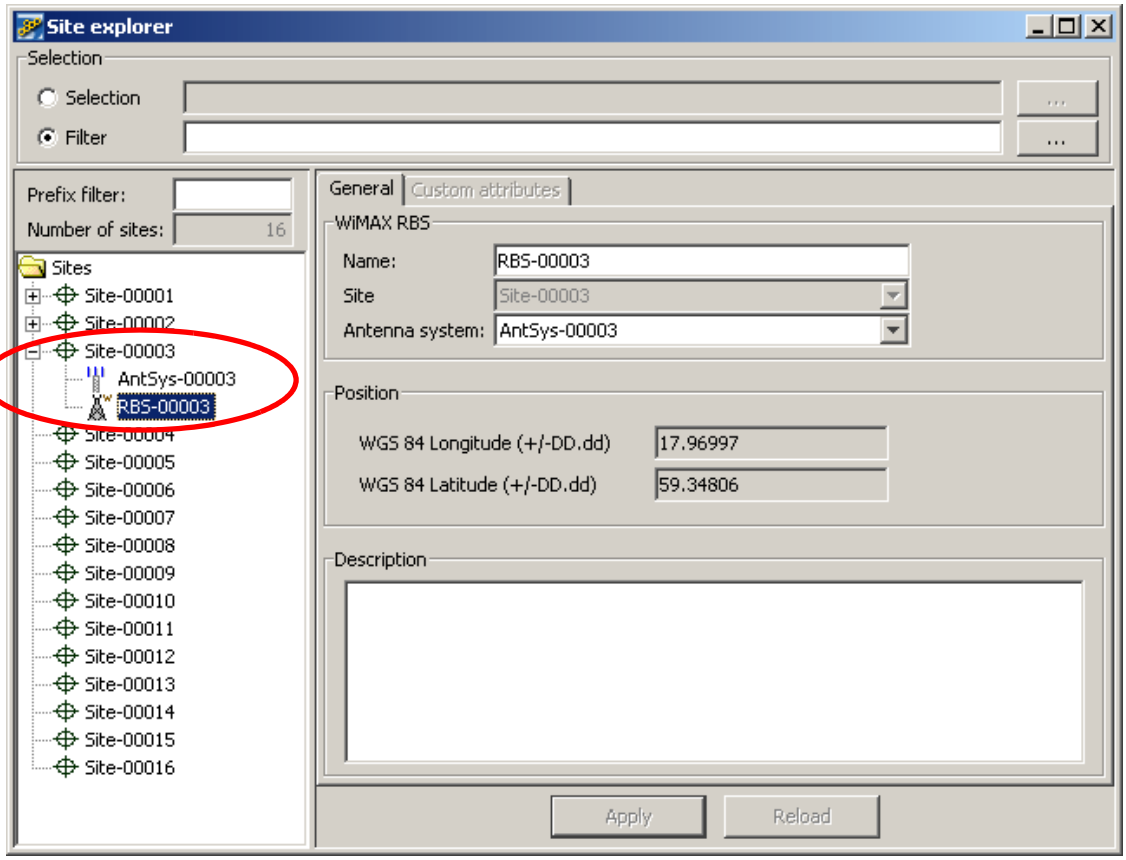
- The site to host the WiMAX RBS is added, see Add WiMAX Sites on page 10-3.
- The antenna system to use is added, see Add WiMAX RBS to a Site (Create From Template) on page 10-5.

Procedure

Follow these steps to add a WiMAX RBS to a site:

1. Select **Utilities↗Site explorer. A list of sites is displayed.**
2. Optionally delimit the number of sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Add↗WiMAX RBS**.
4. If the site has no antenna system, the **Select an antenna system** dialog appears. Click **Add** and **OK**. The antenna system is added to the site.
5. An WiMAX RBS without cells is created under the site.
6. Modify the name of the RBS if required.
7. If you have defined custom attributes for WiMAX RBS, you can select flag values for this specific WiMAX RBS under the **Custom attributes** tab.

8. Click **Apply** to preserve the settings. You now have a a site with antenna system and WiMAX RBS without cells. The result looks as follows:



9. Proceed with Add WiMAX Cell to an RBS on page 10-8 to add the desired number of cells to the RBS.

Fields on the Window

See Fields on Window "WiMAX RBS" on page 10-7.

Add WiMAX Cell to an RBS

You may add up to eight WiMAX cells to each WiMAX RBS.

A WiMAX cell can host one or more antenna branches

Note: *Radio repeaters are not supported in TEMS CellPlanner WiMAX network plans, even though the object is selectable as part of a WiMAX cell.*

Each WiMAX cell uses one channel of the frequency band.

Prerequisites

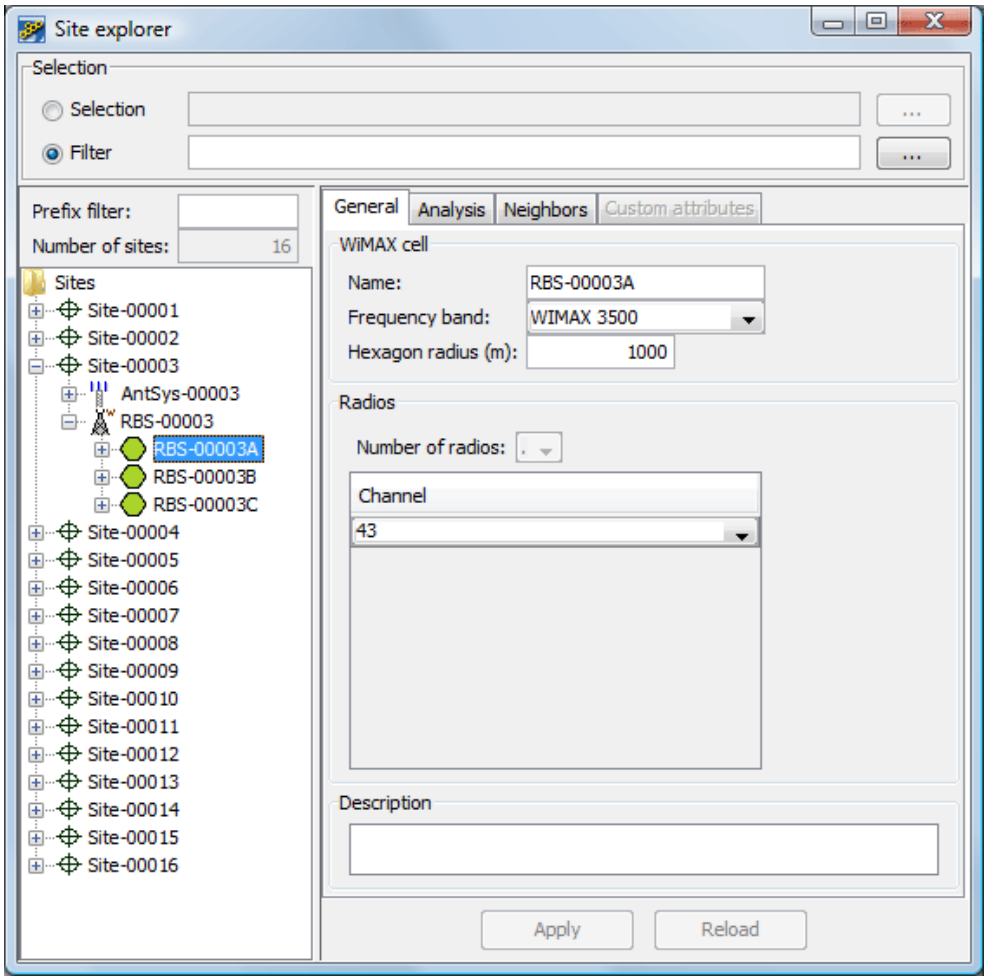
- The RBS of the cell is defined, see Add WiMAX RBS to a Site (Add Without Template) on page 10-7.
- The frequency band to use is defined and carriers selected, see Define WIMAX Frequency Band on page 7-7.

Procedure

Follow these steps to add a WiMAX cell to a WiMAX RBS:

1. Select **Utilities↗Site explorer or Utilities↗WiMAX RBS explorer**. **A list of sites or WiMAX RBSs is displayed**.
2. Optionally delimit the number of sites or WiMAX RBSs by a selection or filter.
3. Right-click an RBS in the tree and select **Add WiMAX cell** from the menu. The **Select a frequency band** window appears.

4. Select a frequency band from the list and click **OK**. The **WiMAX cell** window appears:



5. Modify the hexagon radius if required.
6. Select a channel as carrier if the cell shall be included in the WiMAX Best Server Analysis.
7. Click **Apply** to preserve the settings.
8. Proceed with Select a WiMAX Cell Radio from Step 5 and the subsequent WiMAX cell related procedures.
9. After that, Add Antenna Branch to a WiMAX Cell on page 10-22.

Fields on Window "WiMAX Cell"

Field	Description
Name	Name of the cell. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Frequency band	Frequency band of the cell
Hexagon radius (m)	Radius in meters of the cell hexagons
Channel	The channel to use as carrier, selected from list of channels of the frequency band
Description	Description of the cell

Select a WiMAX Cell Radio

Use this procedure to define basic information about a WiMAX cell.

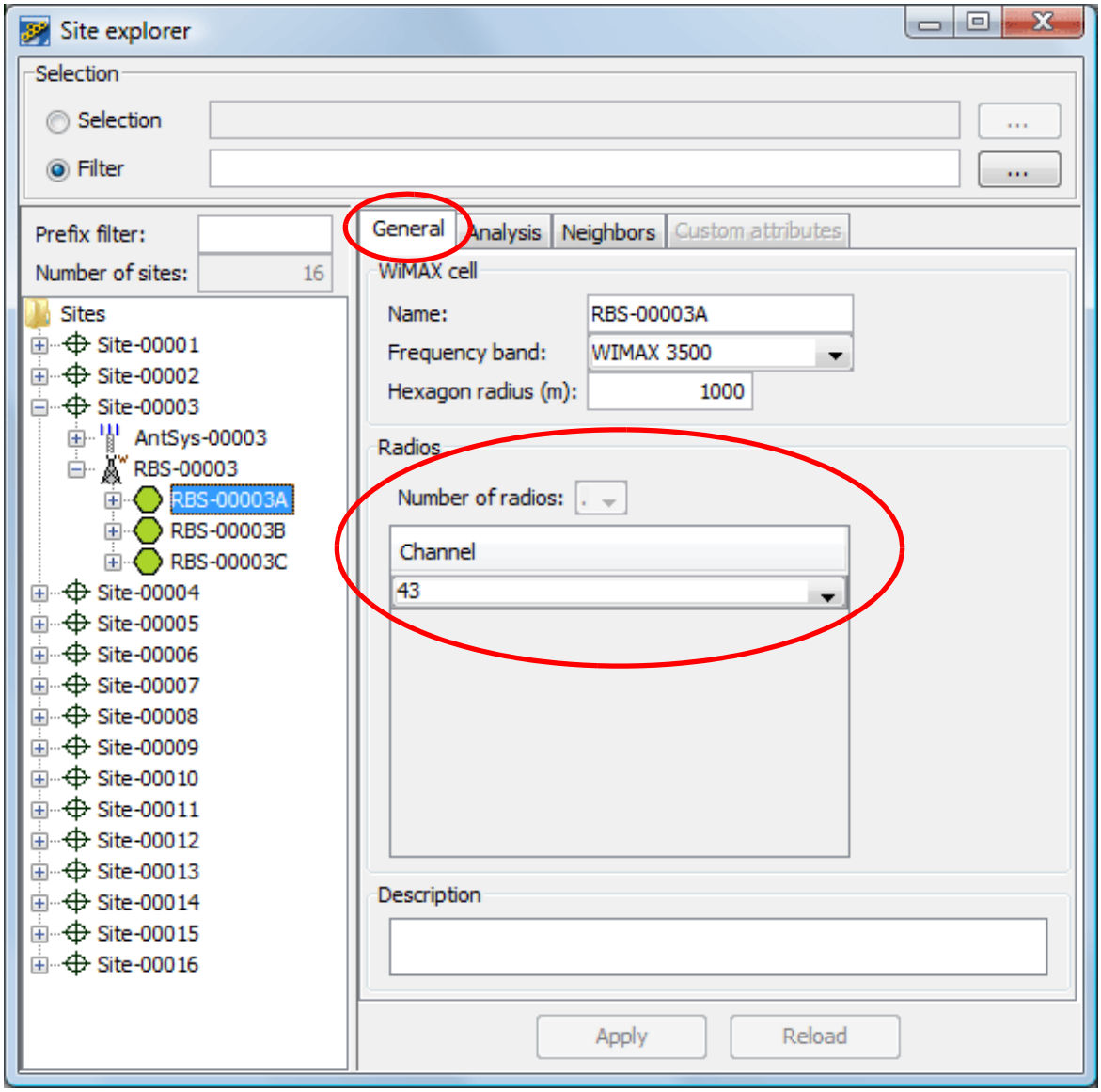
Prerequisites

- The WiMAX cell is added to the RBS, see Add WiMAX Cell to an RBS on page 10-8.
- Carriers are selected for the frequency band, see Add Carriers to Frequency Band on page 7-13.

Procedure

1. Select **Utilities↗Site explorer or Utilities↗WiMAX RBS explorer**. **A list of sites or WiMAX RBSs is displayed**.
2. Optionally delimit the number of sites or WiMAX RBSs by a selection or filter.
3. Locate the WiMAX cell in the tree and select it.
4. Select the **General** tab. The **WiMAX cell - General** window appears.

5. Select a radio from the list of carriers. The result may look as in the following example:



6. Click **Apply** to preserve the radio selection.

Fields on the Window

See Fields on Window "WiMAX Cell" on page 10-11.

Configure WiMAX Cell Analysis Parameters

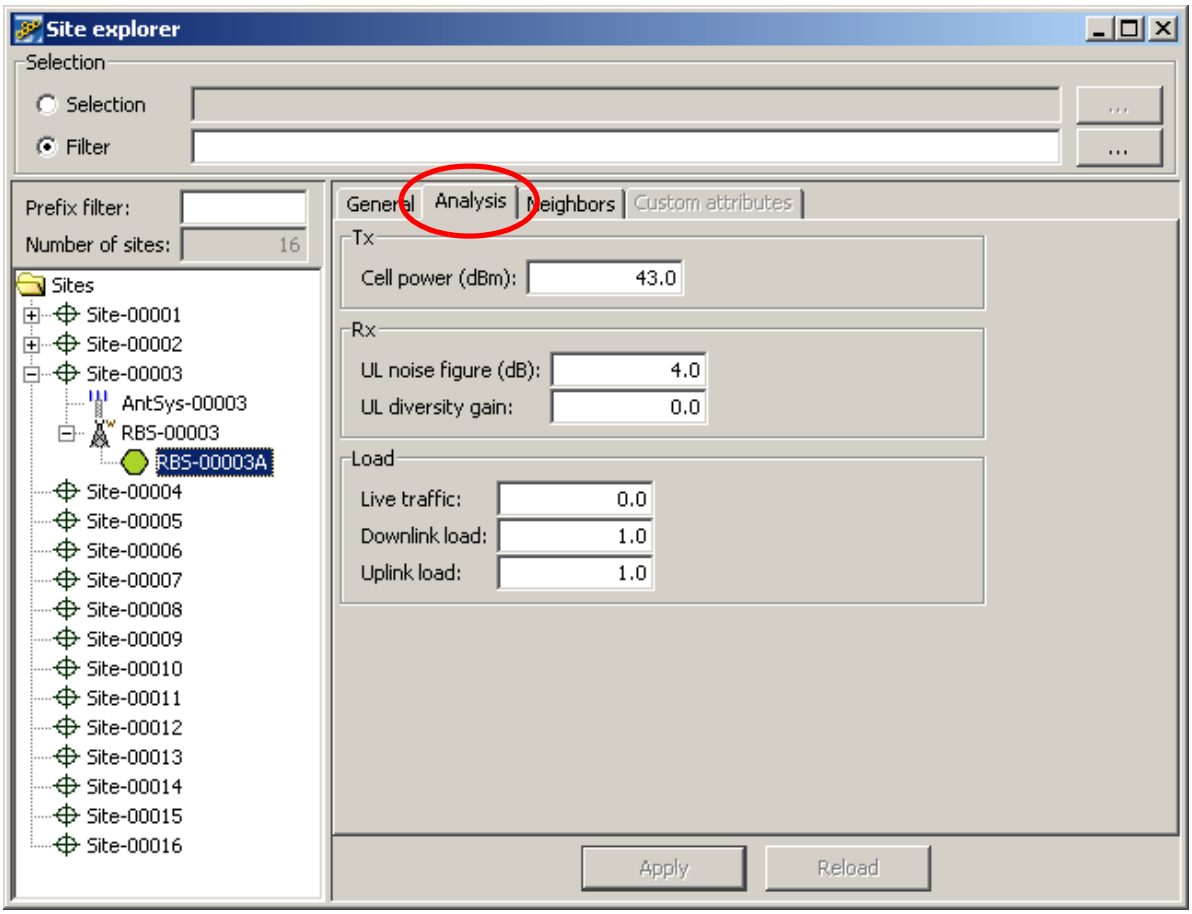
Use this procedure to configure analysis information of a WiMAX cell.

Prerequisites

The WiMAX cell is added to the RBS, see Add WiMAX Cell to an RBS on page 10-8.

Procedure

1. Select **Utilities↗Site explorer or Utilities↗WiMAX RBS explorer**. **A list of sites or WiMAX RBSs is displayed**.
2. Optionally delimit the number of sites or WiMAX RBSs by a selection or filter.
3. Locate the WiMAX cell in the tree and select it.
4. Select the Analysis tab. The WiMAX cell - Analysis window appears:



5. Modify the parameters as required.
6. Click Apply to preserve the settings.

Fields on Window "WiMAX Cell - Analysis"

Field	Description
Tx Cell power (dBm)	Frequency output power. Range: 0 - 60. Default = 43 dBm.
Rx UL noise figure (dB)	The ratio of the self-noise to the thermal noise level. Range: 0-15. Default = 4 dB.
Rx UL diversity gain	Gain in dB due to spatial antenna diversity added to the received signal. Range: 0 - 10. Default = 0.
Live traffic	Number of terminals. Default = 0.
Downlink load	Downlink load on cell. Calculated in traffic analysis. Range: 0 - 1. Default: 1.
Uplink load	Uplink load on cell. Calculated in traffic analysis. Range: 0 - 1. Default: 1.

Add WiMAX Cell Neighbor Relations for Export

Chapter Neighbors in the *TEMS CellPlanner Common Features User's Guide* **contains a more up-to-date description on how you can add, modify and delete neighbors. The descriptions below will be aligned in a later release.**

Use this window to add cell neighbor information to a WiMAX cell. Neighbors may also be added using WiMAX Neighbor Analysis.

Prerequisites

The WiMAX cell is added to the RBS, see Add WiMAX Cell to an RBS on page 10-8.

Procedure

1. Select **Utilities↗Site explorer or Utilities↗WiMAX RBS explorer**. **A list of sites or WiMAX RBSs is displayed**.
2. Optionally delimit the number of sites or WiMAX RBSs by a selection or filter.
3. Locate the WiMAX cell in the tree and select it.
4. Select the **Neighbors** tab. The **Neighbor list** window appears.
5. To create *non-mutual* cell relations, click **Add**. The **Cell selection (Add) window** appears. Select WiMAx cell(s) and apply the selection by clicking **OK**. The added cells appear in the **Neighbor list**.
6. To create *mutual* cell relations, click **Add**. The **Cell selection (Add mutual) window** appears. Select WiMAX cell(s) and apply the selection by clicking **OK**. The added cells appear in the **Neighbor list**.
7. Click **Apply** to preserve the settings.

Fields on Window "WiMAX cell - Neighbors"

Field	Description
(Neighbor list)	Shows the neighbors for a cell, organized by technology and then by RBS. Mutual cell relationships are displayed with a double green cell icon. Non-mutual relationships are displayed with a green/white cell icon.
Add...	Displays the **Cell selection (Add)** window for adding neighbor cells to the highlighted cell. Using this button, the cell relationship is non-mutual.
Add mutual...	Displays the **Cell selection (Add mutual)** window for adding a mutual cell neighbor relationship.
Delete	Deletes a neighbor relationship from a cell
Delete mutual	Deletes a mutual relationship from the original cell and its neighbor
Make mutual	Makes a cell relationship mutual between two cells

Select Custom Attributes for WiMAX Cells

If you have defined custom attributes for WiMAX cell, you can select flag values for specific WiMAX cells under the **Custom attributes** tab. Read more about custom attributes and flag types in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX Fixed Subscriber Sites

A WiMAX fixed subscriber site hosts one WiMAX fixed subscriber.

Read more About WiMAX Fixed Subscribers on page 14-10.

Add WiMAX Fixed Subscribers

You may add one fixed subscriber to a WiMAX fixed subscriber site.

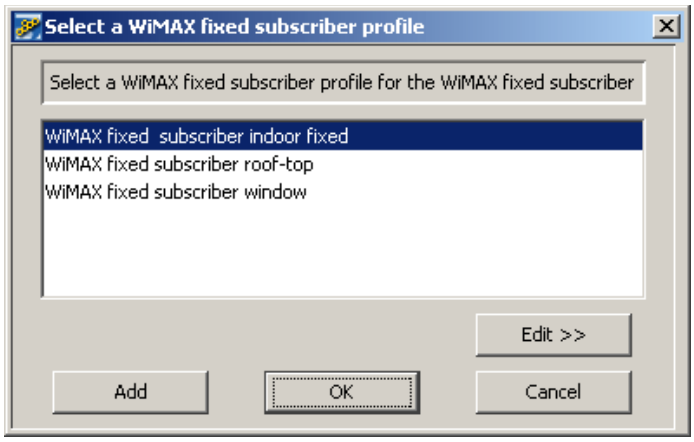
Prerequisites

- The WiMAX site is added, see Add WiMAX Sites on page 10-3.
- The fixed subscriber profile to use is defined, see Define WiMAX Fixed Subscriber Profile on page 7-29.

Procedure

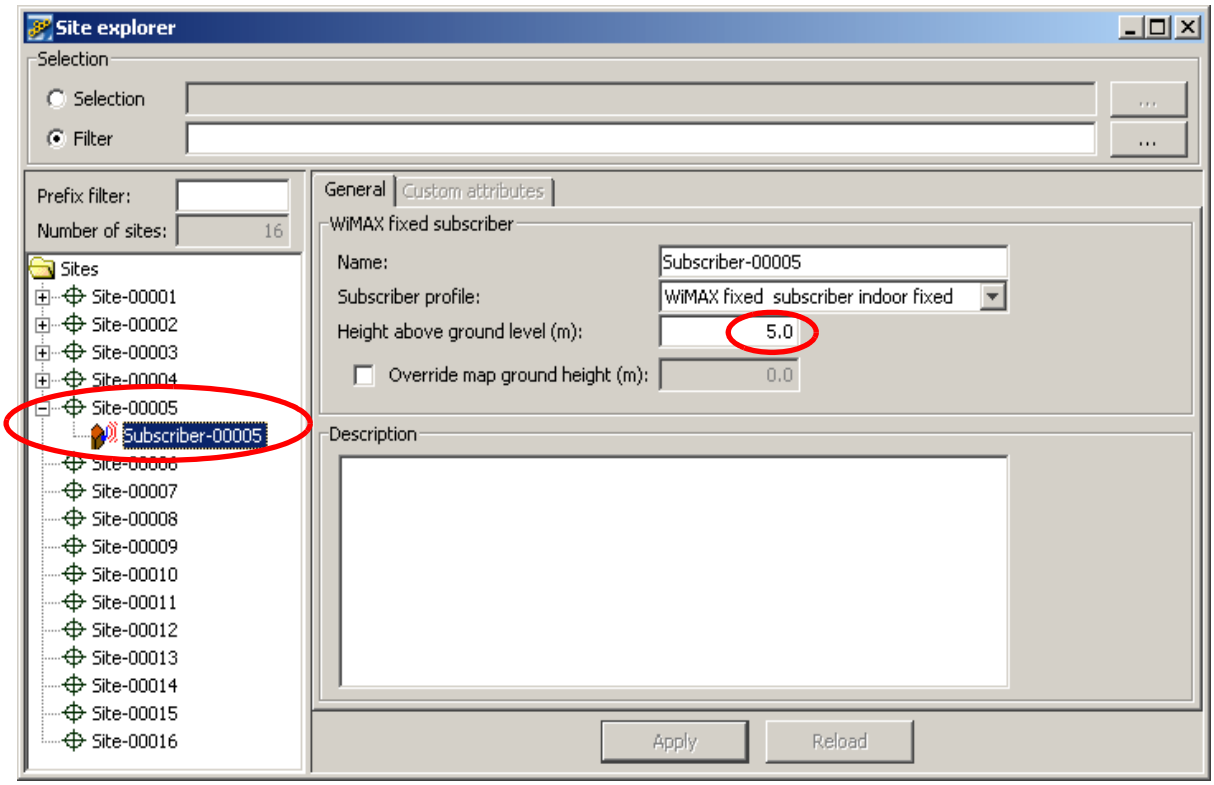
Follow these steps to add a WiMAX fixed subscriber to a WiMAX site:

1. Select **Utilities↗Site explorer**. **A list of sites is displayed**.
2. Optionally delimit the number of sites or WiMAX sites by a selection or filter.
3. Right-click site in the tree and select **Add WiMAX fixed subscriber** from the menu. The **Select a WiMAX fixed subscriber profile** window appears:



4. Select a subscriber profile from the list and click **OK**.

The **WiMAX fixed subscriber** window appears:



Note: *The parameter **Height above ground level** of a fixed subscriber **has an initial value of 5 meters, but the exact height must be configured or imported along with the position. Although the antenna height is configured as a terminal type parameter, that value is ignored at analysis of a fixed subscriber. Instead, the Height above ground level** in the above window **is used**.*

5. If you have defined custom attributes for WiMAX fixed subscribers, you can select flag values for this fixed subscriber under the **Custom attributes** tab.
6. Click **Apply** to preserve the settings.

Fields on Window "WiMAX Fixed Subscriber"

Field	Description
Name	Name of the cell. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Subscriber profile	Selected from list of WiMAX fixed subscriber profiles
Height above ground level (m)	Antenna height above ground level. Overrides the antenna height of the terminal. Minimum: 1 m. Initial: 5 m.

Field	Description
Override map ground height (m)	Explicitly defined ground height above mean sea level (AMSL). Overrides the elevation map, for example to add the height of a building.
Description	Description of the fixed subscriber.

Antenna Systems

Add Antenna System to a Site (Create From Template)

Each WiMAX RBS site shall have one antenna system defined.

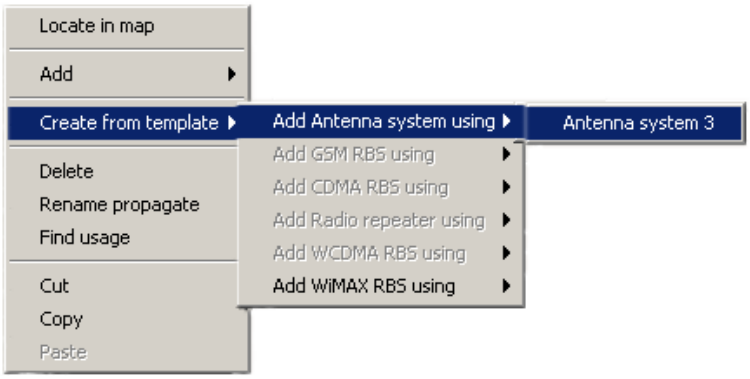
The most efficient way to add antenna related network elements (antennas, feeder cables, TMAs) to a site is to include those elements in an antenna system template and add an antenna system created from that template.

Prerequisites

- The site to use the antenna system is added to the project, see Add WiMAX Sites on page 10-3.
- The antenna system template is defined, see Antenna System Templates on page 9-4.

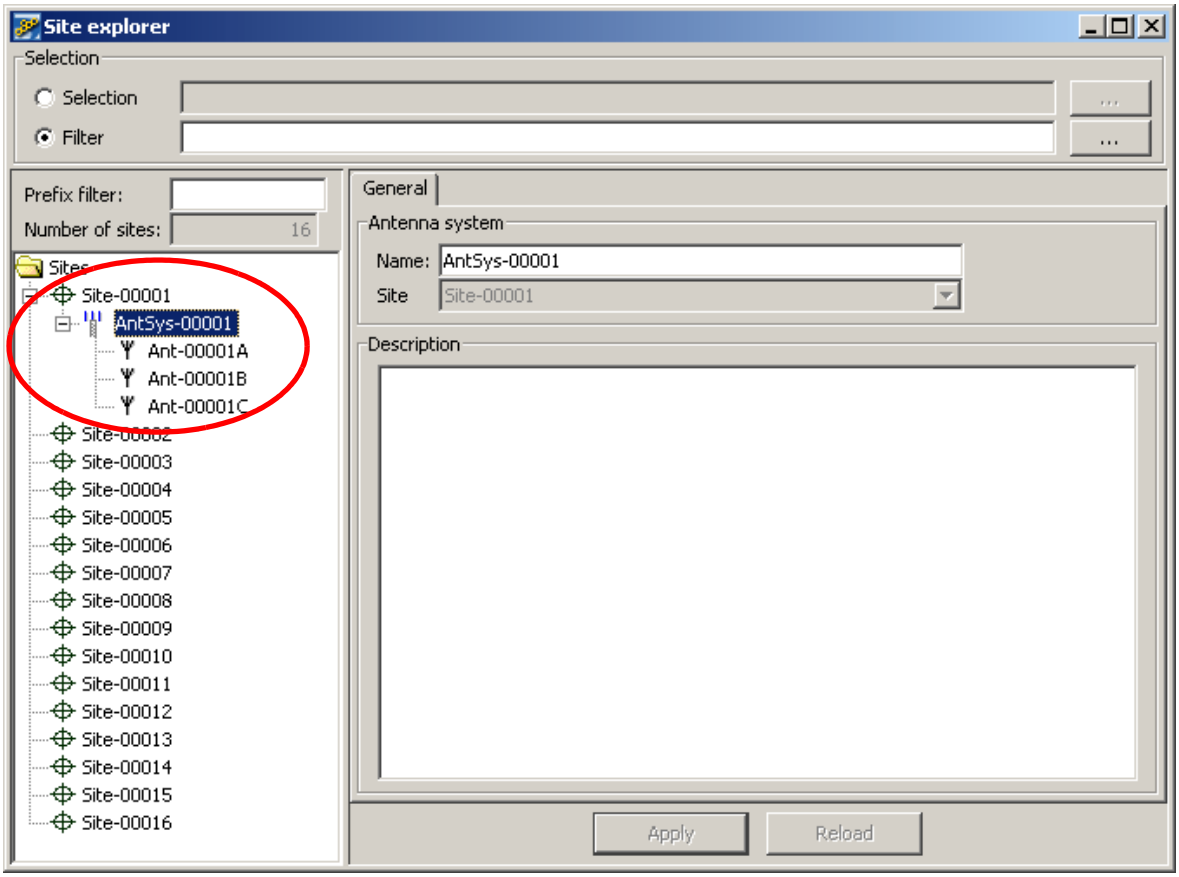
Procedure

1. Select **Utilities↗Site explorer. A list of sites is displayed.**
2. Optionally delimit the number of sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Create from template↗Add Antenna system using↗<Antenna system template>, as in the following example:**



4. The network elements defined from the antenna system template are created under the site.

5. Click **Apply** to preserve the settings.The result looks as in the following example:



Fields on Window "Antenna System"

Field	Description
Name	Name of the antenna system. Maximum 128 alphabetical or numerical characters. Do not use /,\,' or %.
Site	Name of the site. Not editable.
Description	Description of the antenna system

Add Antenna System to a Site (Add Without Template)

Instead of using an antenna system template, an antenna system can be added in a more "raw" way to the site. You then add first the antenna system and subsequently all its network elements one by one.

Prerequisites

The site to use the antenna system is added to the project, see Add WiMAX Sites on page 10-3.

Procedure

1. Select **Utilities↗Site explorer. A list of sites is displayed.**
2. Optionally delimit the number of sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Add↗ Antenna system**. An empty antenna system is created under the site.
4. Add network elements to the antenna system: Right-click on the antenna system and select the network element to add, for example **Add antenna**. The network element is created under the antenna system.

Note: *Do not add any ASC. It is selectable, but ASCs are not used in WiMAX networks.*

Configure Antenna System Parameters

Use this procedure to modify the parameters of an antenna system of a WiMAX RBS site.

Prerequisites

The antenna system is added to the project, see Add Antenna System to a Site (Create From Template) on page 10-19 or Add WiMAX RBS to a Site (Create From Template) on page 10-5.

Procedure

1. Select **Utilities↗Site explorer. A list of sites is displayed.**
2. Optionally delimit the number of sites by a selection or filter.
3. Locate the site in the browser, right-click on the site and select **Add↗ Antenna system**. An empty antenna system is created under the site.
4. Add network elements to the antenna system: Right-click on the antenna system and select the network element to add, for example **Add antenna**. The network element is created under the antenna system.

Note: *Do not add ASC. It is selectable, but ASCs are not used in WiMAX networks.*

Antenna Branches

A WiMAX antenna branch defines the antenna type, propagation models, Tx power and optionally cable repeater to use in the cell.

Read more about antenna branches in About Antenna Branches on page 9-10.

Add Antenna Branch to a WiMAX Cell

If you have created a WiMAX cell using the wizard described in Add WiMAX RBS to a Site (Create From Template) on page 10-5, an antenna branch is already created for each cell, provided that an antenna branch template is defined.

The prerequisites and the procedure for adding an antenna branch is the same as for adding an antenna branch template. The only difference is that you add the "real" antenna branch from the **Site explorer** or the **WiMAX RBS explorer**, by selecting the cell, right-click and select **Add antenna branch**.

For details, see Define WiMAX Antenna Branch Template on page 9-10. Note that you must select two propagation models. The first propagation model is used for mobile terminals, while the point-to-point propagation model is used for fixed subscribers.

11
Filters

Filters limit the operations on a WiMAX network plan, logically or geographically.

Read chapter *Filters* in the *TEMS CellPlanner Common Features User's Guide* to learn more on this topic.

12
Import and Export of WiMAX Data

This chapter describes how to import and export WiMAX related data such as WIMAX fixed subscribers and neighbor lists.

Topics **Page**

About Import and Export of WiMAX Data 12-2
Import and Export of WiMAX Fixed Subscribers 12-2
Import and Export of Neighbor Lists 12-2
Import and Export of Other Data 12-2

About Import and Export of WiMAX Data

You can import/export the following WiMAX specific data to/from a WiMAX project:

- WiMAX fixed subscribers
- WiMAX neighbor lists

You can also import/export generic (non-LTE) data as described in Import and Export of Other Data on page 12-2.

Import and Export of WiMAX Fixed Subscribers

You can export and import WiMAX fixed subscribers with their site positions.

See:

- *Import Fixed Subscribers* in the *TEMS CellPlanner Common Features User's Guide*
- *Export Fixed Subscribers* in the *TEMS CellPlanner Common Features User's Guide*
- WiMAX Fixed Subscriber Sites on page 10-16 for information on how to create, modify, and analyze fixed subscribers in TEMS CellPlanner.

Import and Export of Neighbor Lists

You can export and import intra-technology WiMAX neighbor lists.

See:

- *Import Cell Neighbors Text File* in the *TEMS CellPlanner Common Features User's Guide*
- *Export Cell Neighbors Text File* in the *TEMS CellPlanner Common Features User's Guide*
- WiMAX Neighbor Analysis on page 14-17 for information on how to analyze neighbor lists in TEMS CellPlanner.

Import and Export of Other Data

Except for fixed subscribers and neighbor lists, you can also import/export the following data to/from a WiMAX project:

- TCP XML, project in XML format for cross-version compatibility

  Tip: Try any of the demo projects delivered in XML format together with this software. See *Use a Demo Project* in the *TEMS CellPlanner Common Features User's Guide*.

- EET/Planet 2.x antennas
- Generic text file
- Generic map file (import only)

For detailed information, refer to *Importing Data* and *Exporting Data* in the *TEMS CellPlanner Common Features User's Guide*.

13
Pathloss

Pathloss calculations predict the expected coverage of a network plan. The predictions are a prerequisite for further WiMAX Analysis.

Refer to the *TEMS CellPlanner Common Features User's Guide* for information on how to calculate, puncture and view pathloss.

14 WiMAX Analysis

This chapter describes how to analyze the coverage, interference and traffic performance in a WiMAX network.

Topics **Page**

About WiMAX Analysis 14-2
About Traffic Cases in WiMAX Analysis 14-2
About Fade Margin and Interference Margin Parameters 14-2
WiMAX Best Server Analysis 14-4
Calculate WiMAX Best Server 14-4
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Generate WiMAX Neighbor Lists 14-17
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Add Individual Neighbor Relations 14-25
Show Neighbor Cells on Map Display 14-27
Troubleshooting Analysis Results 14-30
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Interference at Cell Borders Reduced by PUSC 14-30

About WiMAX Analysis

TEMS CellPlanner offers several analysis functions for your WiMAX network plan. The analysis is performed by complex algorithms, based on how you have configured your WiMAX network. By using these analysis functions you obtain plots and reports of coverage, interference and traffic performance.

To perform a complete analysis of a WiMAX network plan, take the following steps in the mentioned order:

1. WiMAX Best Server Analysis.
   Analyzes the coverage of any terminal type, and produces a *Received power per carrier matrix* (a CPLM for every frequency) used by other analysis functions.
2. WiMAX Interference Analysis, considering PUSC/FUSC
3. WiMAX Fixed Subscriber Analysis, coverage excluding mobile terminals
4. WiMAX Traffic Performance Analysis, with or without interference

About Traffic Cases in WiMAX Analysis

A *traffic case* is a combination of a terminal type and a bearer.

Before starting the analysis, you select the traffic case(s) to analyze. A WiMAX bearer is associated with exactly one carrier. The analysis of a traffic case considers only the cells using the same carrier frequency as the selected bearer.

When the analysis is completed, information for one plot per traffic case is stored for later retrieval.

To view the results of the analysis, you select the plots from a list of plots sorted per traffic case.

Traffic cases are used in all WiMAX analysis functions except for fixed subscriber analysis.

About Fade Margin and Interference Margin Parameters

The fade margin and interference margin parameters in Fields on Window "WiMAX Best Server Analysis" and Fields on Window "WiMAX fixed subscriber analysis" are used when calculating the best serving cells for mobile terminals and fixed subscribers respectively.

The DL net received power is calculated as the DL signal strength minus the **DL fade margin** and the **DL interference margin**.

The UL net received power is calculated as the UL signal strength minus the **UL fade margin** and the **UL interference margin**.

To be counted as a best serving cell, the cell's DL as well as UL net received power must exceed the receiver threshold of at least one MCS of the selected WiMAX MCS Selections.

The UL fade and interference margins are also used when calculating the UL Power Margin of each best serving cell.

WiMAX Best Server Analysis

The purpose of the WiMAX best server analysis is to find the best serving cells in a WiMAX project and create plots displaying the best servers.

The best server analysis optionally produces a *Received power per carrier matrix* (a CPLM for every frequency) required by WiMAX Interference Analysis, WiMAX Traffic Performance Analysis and WiMAX Neighbor Analysis.

The results are stored and can anytime be viewed in WiMAX Best Server Plots showing the coverage, data rate and the best MCS anywhere in the network.

Calculate WiMAX Best Server

Use this procedure to find the best serving cells in a WiMAX network.

Prerequisites

- A valid WiMAX license is available, see chapter *Licenses* in the *TEMS CellPlanner Common Features User's Guide*.
- WiMAX sites with cells are defined, see Add WiMAX Sites on page 10-3 and Add WiMAX Cell to an RBS on page 10-8.
- The terminal types to include in traffic cases are defined, see Define WiMAX Terminal Types on page 8-5.
- The bearers to include in traffic cases are defined, see Define WiMAX Bearers on page 7-16.
- Results from Pathloss predictions are available.

Procedure

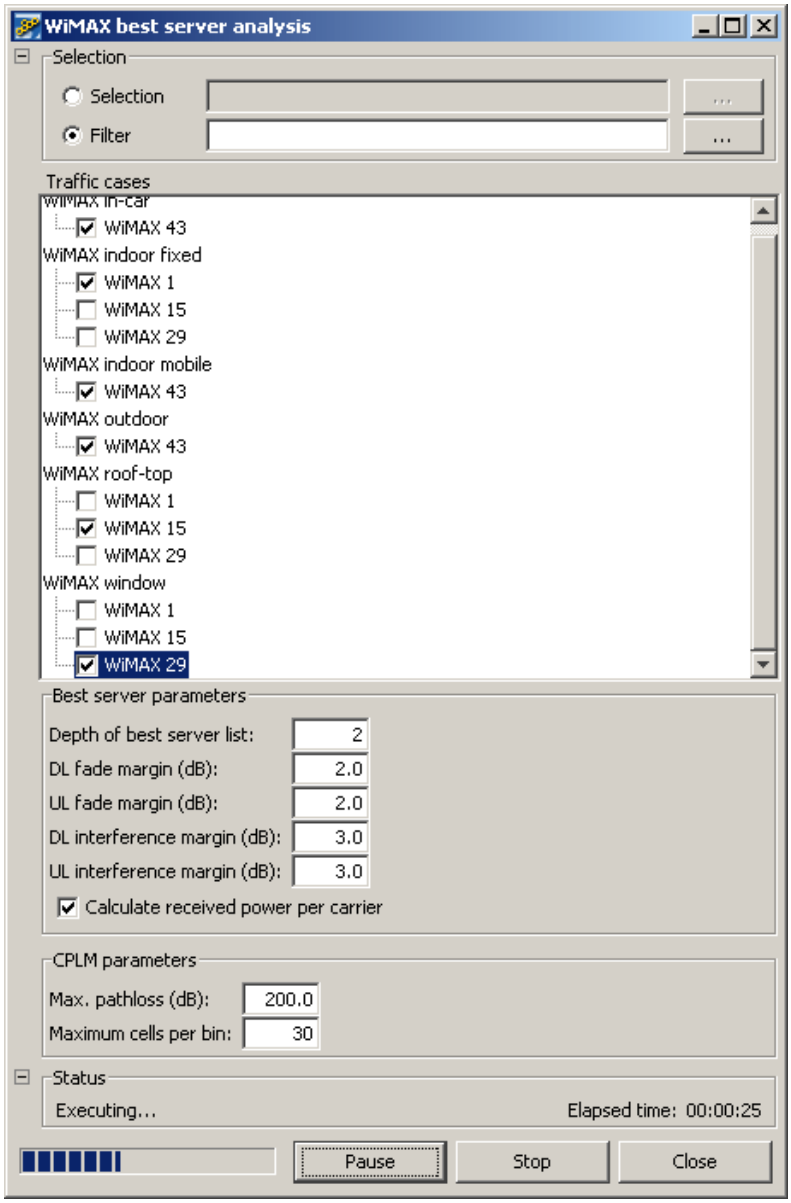
Follow these steps to calculate the best serving cell(s) in your WiMAX project:

1. Select **Analysis↗WiMAX↗Calculate best server.** The **WiMAX best server analysis** window appears.
2. Optionally limit the number of sites included in the analysis by using a selection or filter.
3. Select the traffic case(s) for which you want to find the best server(s).

Note: *The plot of a traffic case will only display the coverage and data rate of the cells using the same carrier as the bearer of the traffic case.*

4. If the composite path loss matrix (CPLM) created from this analysis shall be used in any other WiMAX analysis, select the **Calculate received power per carrier** option.
5. Update the other parameters as required.

6. Click **Start** to begin the calculation. The status bar indicates the progress, as in the following example:



7. The results are stored and can be analyzed as plots, see WiMAX Best Server Plots on page 15-2.

Fields on Window "WiMAX Best Server Analysis"

Field	Description
Traffic cases	A list of available traffic cases. A traffic case is a combination of a terminal type and a bearer. The bearer defines the carrier frequency to be used in the analysis.
Depth of best server list	Determines the number of plots to generate, which for every bin on the map shows the identity or signal strength of the first, second, and third ranked cell that may serve a terminal located in the bin. Range = 1 - 30. Default = 2.
DL fade margin (dB) UL fade margin (dB)	Estimated DL (UL) fading in the network. Range: 0 - 30. Default = 0 dB. See About Fade Margin and Interference Margin Parameters.
DL interference margin (dB) UL interference margin (dB	Estimated DL (UL) interference in the network. Range: 0 - 30. Default = 0 dB. See About Fade Margin and Interference Margin Parameters.
Calculate received power per carrier	For each carrier, the calculated received power per cell from all cells using that carrier. The result is stored as a matrix. This calculation is time consuming, but the *Received power per carrier matrix* is required by the following analysis functions: • WiMAX Interference Analysis • WiMAX Traffic Performance Analysis • WiMAX Neighbor Analysis
Received power per carrier matrix	
Max. pathloss (dB)	Maximum pathloss in dB to consider in the calculations. Range: 10 - 200. Default = 200 dB.
Maximum cells per bin	Maximum number of cells from which the pathloss values are calculated in one bin. Range: 1 - 30. Default = 30.
Start	Initiates the calculation
Stop	Stops an ongoing calculation
Close	Stops any ongoing calculation and closes the window

WiMAX Interference Analysis

The purpose of the interference analysis is to analyze the downlink interference in a WiMAX network and create interference plots.

The interference can be calculated for a WiMAX network plan using FDD or synchronized TDD, but not for unsynchronized TDD.

It is possible to use PUSC mode for terminals in the more interfered parts of the cells and FUSC mode for terminals in the less interfered parts of the cells.

The results are stored and can be viewed as plots, showing the interference anywhere in the WiMAX network, see WiMAX Interference Plots on page 15-11.

Calculate WiMAX Interference

Use this procedure to calculate the interference in the WiMAX network.

Prerequisites

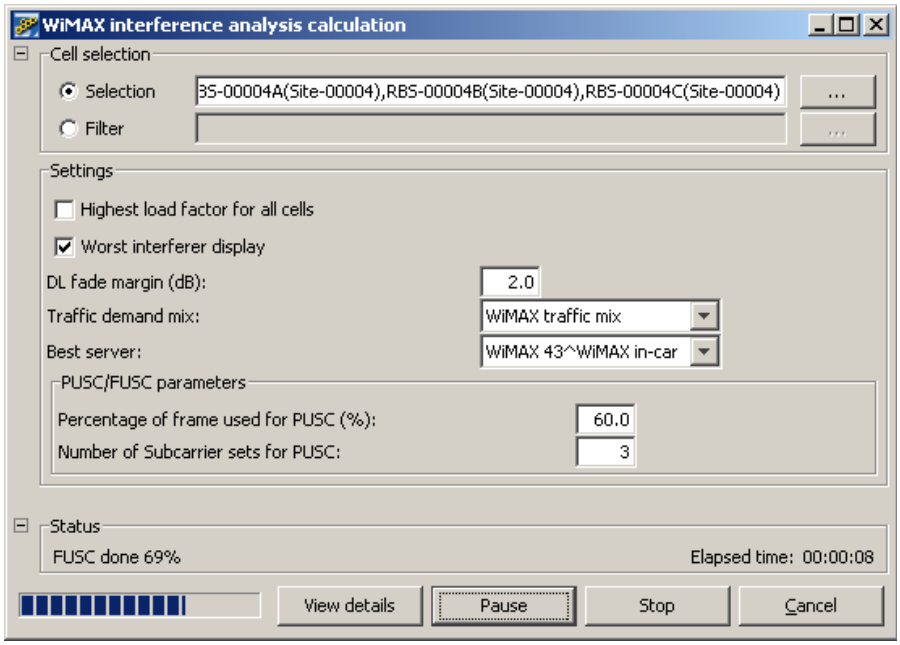
- A valid WiMAX license is available, see chapter *Licenses* in the *TEMS CellPlanner Common Features User's Guide*.
- WiMAX sites with cells are defined, see Add WiMAX Sites on page 10-3 and Add WiMAX Cell to an RBS on page 10-8.
- The cells to analyze must have a frequency defined.
- The terminal types to include in traffic cases are defined, see Define WiMAX Terminal Types on page 8-5.
- The bearers to include in traffic cases are defined, see Define WiMAX Bearers on page 7-16.
- Results from Pathloss predictions are available.
- Results from WiMAX Best Server Analysis are available for the traffic cases to analyze. The results must include a *Received power per carrier matrix*.
- If PUSC mode shall be used, the PUSC interference rejection must have a positive value, measured in dB, see Configure WiMAX Project Parameters on page 5-5.

Procedure

Follow these steps to calculate the interference in your WiMAX project:

1. Select **Analysis↗WiMAX↗Calculate interference.** The **WiMAX interference analysis calculation** window appears.
2. Optionally limit the number of sites included in the analysis by using a selection or filter.

3. To override the load factors given in the cell configuration, select **Highest load factor for all cells**.
4. Select a traffic demand mix.
5. Select a traffic case for the **Best server**. The selected traffic case defines the frequency and best server area for which the calculation shall be performed.
6. Modify the other parameters as required.
7. Click **Start** to begin the calculation. The status bar indicates the progress, as in the following example:



8. The results are stored and can be analyzed as plots, see WiMAX Interference Plots on page 15-11.

Fields on Window "WiMAX interference analysis calculation"

Field	Description
Highest load factor for all cells	If selected, the load factor for individual cells are discarded and highest possible load factor will be used for all cells. Affects the collision factor. The highest possible load factor is 1 (100%). Default: Not selected.
Worst interferer display	If selected, a worst co-channel interferer plot is generated. All other plots are automatically generated. Default: Selected.
DL fade margin (dB)	Estimated DL fading in the network. The DL signal strength is reduced by this value. Range: 0 - 30. Default = 0 dB

Field	Description
Traffic demand mix	A mix of terminal types and their respective contribution to the load in the network, optionally with a geographic distribution.
Best server	A list of available traffic cases. The selected traffic case defines the frequency and best server area for which the calculation shall be performed.
PUSC/FUSC parameters	
Percentage of frame used for PUSC (%)	A value higher than 0 enables PUSC mode. Range: 0 - 100. Default = 0%.
Number of subcarrier sets for PUSC	A value higher than 1 enables PUSC mode. Range: 1 - 6. Default = 1.
View details	Displays the result of the calculation
Start	Initiates the calculation
Stop	Stops an ongoing calculation
Close	Stops any ongoing calculation and closes the window

WiMAX Fixed Subscriber Analysis

The purpose of this function is to analyze the coverage of fixed subscribers in a WiMAX network, find their best serving cell(s) and create a coverage report.

The results are stored and can anytime be viewed in a report, see Generate WiMAX Fixed Subscriber Report on page 16-3.

About WiMAX Fixed Subscribers

A *WiMAX fixed subscriber* is the TEMS CellPlanner model of a non-mobile or nomadic terminal in a WiMAX network, as described in the IEEE 802.16d (2004) standard. A nomadic (semi-mobile) terminal can be connected to different WiMAX cells at different times, but handover during a call is not possible.

A fixed subscriber is defined by its subscriber profile and height above ground level. In reality it is a terminal, but as it has a fix location it is configured as a site with a subscriber profile pointing out a terminal type.

Analysis of Fixed Subscribers versus Mobile Terminals

Analysis of fixed subscribers is based on point-to-point connections, while analysis of mobile subscribers is based on the area coverage of the cells. For this reason the antenna branch of a cell includes one "normal" propagation model for mobile subscribers and one point-to-point propagation model for fixed subscribers. See Add Antenna Branch to a WiMAX Cell on page 10-22.

A fixed subscriber may in TEMS CellPlanner use more than one frequency. To model multi-frequency use in a fixed subscriber, you assign multiple bearers to its terminal type, where each bearer is associated with one carrier (= frequency). WiMAX cells may be configured to use different carrier frequencies in each sector, to reduce interference. The fixed subscribers shall be configured to use all carrier frequencies of the covering cells. For each fixed subscriber, the WiMAX Fixed Subscriber Analysis evaluates the signal strength of all supported frequencies and simulates a connection to the strongest of the evaluated cells.

For a mobile terminal type, it is possible to assign more than one frequency. That is, you can assign more than one bearer to each terminal type. However, the analysis for mobile terminals considers only one frequency at a time.

Required Distance to WiMAX Fixed Subscriber

If a WiMAX fixed subscriber is too close to a WiMAX RBS site, the analysis results are not reliable. The recommended minimum distance is stated in Add WiMAX Sites on page 10-3.

Calculate Best Server for WiMAX Fixed Subscribers

Use this procedure to find the best serving cells for WiMAX fixed subscribers.

Prerequisites

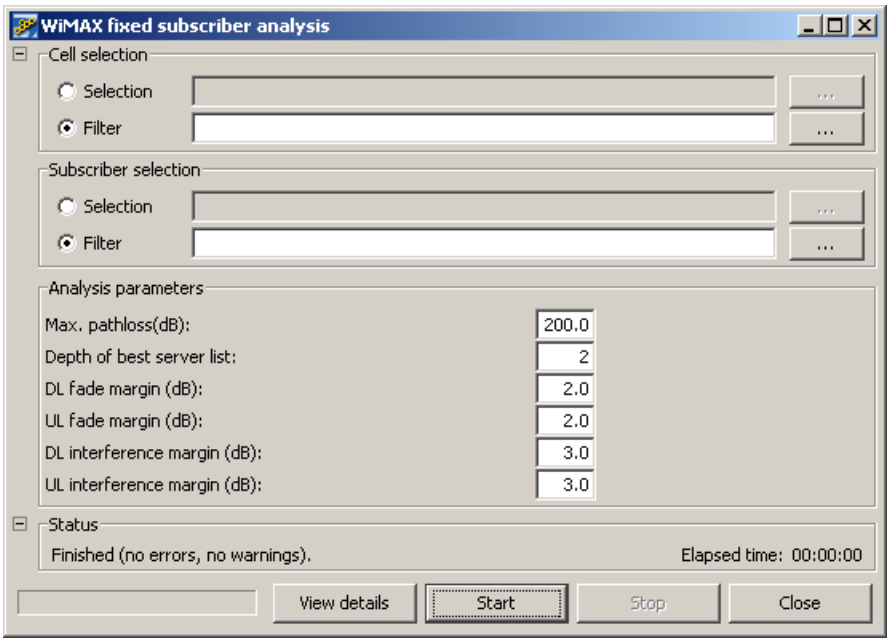
- A valid WiMAX license is available, see chapter *Licenses* in the *TEMS CellPlanner Common Features User's Guide*.
- WiMAX sites with cells are defined. See Add WiMAX Sites on page 10-3 and Add WiMAX Cell to an RBS on page 10-8.
- Fixed subscribers are defined, either
  - imported, see the *TEMS CellPlanner Common Features User's Guide*, or
  - manually added, see Add WiMAX Fixed Subscribers on page 10-16
- Results from Pathloss predictions of fixed subscribers are available.

Procedure

Follow these steps to analyze the coverage of WiMAX fixed subscribers:

1. Select **Analysis↗WiMAX↗Calculate best server for fixed subscribers.** The **WiMAX fixed subscriber analysis** window appears.
2. Optionally limit the number of cells included in the analysis by using a selection or filter.
3. Optionally limit the number of fixed subscribers included in the analysis by using a selection or filter.
4. Modify the analysis parameters as required.

5. Click **Start** to begin the calculation. The status bar indicates the progress, as in the following example:



6. The results are stored and can be analyzed by generating and studying a report, see Generate WiMAX Fixed Subscriber Report on page 16-3.

Fields on Window "WiMAX fixed subscriber analysis"

Field	Description
Cell selection	Selection or filter to limit the number of cells to analyze
Subscriber selection	Selection or filter to limit the number of fixed subscribers to analyze
Analysis parameters	
Max. pathloss (dB)	The maximal allowed pathloss. Fixed subscriber terminals exceeding this value are excluded from the analysis, visualized in the report as empty best server prediction results. Range: 10 - 200. Default = 200 dB.
Depth of best server list	Determines the number of plots to generate, which for every bin on the map shows the identity or signal strength of the first, second, and third ranked cell that may serve a terminal located in the bin. Range = 1 - 30. Default = 2.
DL fade margin (dB)	Estimated DL (UL) fading in the network. Range: 0 - 30. Default = 0 dB. See About Fade Margin and Interference Margin Parameters.
UL fade margin (dB)	

Field	Description
DL interference margin (dB)	Estimated DL (UL) interference in the network. Range: 0 - 30. Default = 0 dB. See About Fade Margin and Interference Margin Parameters.
UL interference margin (dB	
View details	Displays the result of the calculation
Start	Initiates the calculation
Stop	Stops an ongoing calculation
Close	Stops any ongoing calculation and closes the window

WiMAX Traffic Performance Analysis

The purpose of the traffic performance analysis is to calculate and plot downlink and uplink traffic and resource utilization in the cells of a WiMAX network.

The results are stored and can anytime be viewed as plots or as a report, see WiMAX Traffic Performance Plots on page 15-18 and WiMAX Traffic Analysis Report on page 16-6.

Calculate WiMAX Traffic Performance

Use this procedure to calculate the amount of traffic in a WiMAX network.

Prerequisites

- A valid WiMAX license is available, see chapter *Licenses* in the *TEMS CellPlanner Common Features User's Guide*.
- The terminal types and bearers to analyze as traffic cases are defined. See About Traffic Cases in WiMAX Analysis.
- Results from WiMAX Best Server Analysis are available.
- If interference shall be considered in traffic analysis plots and report, the results from WiMAX Interference Analysis must be available.

Procedure

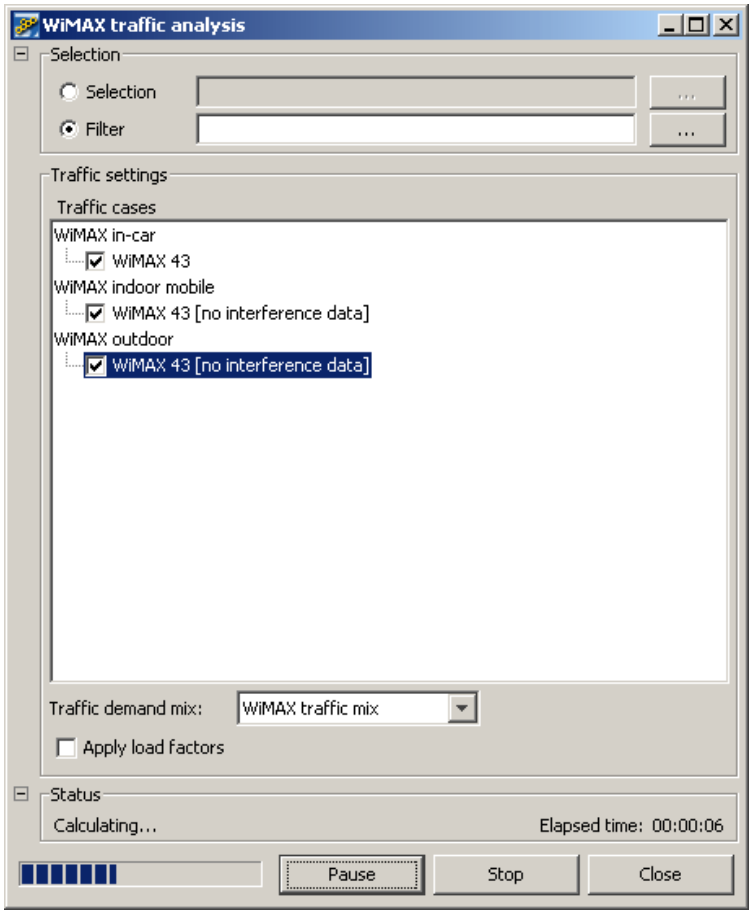
Follow these steps to analyze the traffic performance in a WiMAX network:

1. Select **Analysis↗WiMAX↗Calculate traffic performance.** The **WiMAX traffic analysis** window is appears.
2. Optionally limit the number of cells included in the analysis by using a selection or filter.
3. Select the traffic case(s) to analyze.
4. Select a traffic demand mix.

Note: *Only the traffic demands supported by any of the selected traffic cases are included in the analysis.*

5. Select **Apply load factors** if you want to update the cell parameters **DL load factor** and **UL load factor** with the obtained DL and UL utilization factors from the traffic analysis. These calculated values will then be used in subsequent WiMAX Interference Analysis.

6. Click **Start** to begin the calculation. The status bar indicates the progress as in the following example:



7. The results are stored and can be analyzed by generating and studying a report, see WiMAX Traffic Analysis Report on page 16-6, or by viewing the plots, see WiMAX Traffic Performance Plots on page 15-18.

Fields on Window "WiMAX Traffic Analysis"

Field	Description
Traffic cases	A list of available traffic cases. A traffic case is a combination of a terminal type and a bearer. The bearer defines the carrier frequency to be used in the analysis. For each selectable traffic case it is indicated whether an interference calculation has been performed or not. If a bearer selected as part of a traffic case contains more than one carrier, a separate traffic analysis is performed for each carrier and generates separate results per carrier.
Traffic demand mix	A list of available traffic demand mixes, with traffic demands. A traffic demand consists of a traffic case, a weight factor and a traffic distribution. The traffic distribution may be uniform over the area or be geographically distributed by a traffic density map. Only the traffic demands supported by any of the selected traffic cases are included in the analysis.
Apply load factors	If selected, the cell parameters **DL load factor** and **UL load factor** are updated with the obtained DL and UL utilization factors from the traffic analysis, to be used in subsequent WiMAX Interference Analysis. Default: Not selected.
Start	Initiates the analysis
Stop	Stops an ongoing analysis
Close	Stops any ongoing analysis and closes the window

WiMAX Neighbor Analysis

Chapter Neighbors in the *TEMS CellPlanner Common Features User's Guide* contains a more up-to-date description on how you can add, modify and delete neighbors. The descriptions below will be aligned in a later release.

The purpose of the WiMAX neighbor analysis is to generate lists of intra-technology (WiMAX to WiMAX), intra-frequency neighbor cells for a selected traffic case.

For each cell using the same carrier as defined in the selected traffic case, the analysis evaluates possible neighbor cells. Neighbor cells are the cells to/from which handover is possible from/to the analyzed cell. For each analyzed cell, the analysis presents the cells allowing handover in a *neighbor list*. You accept the contents of the neighbor list by applying the list.

This is the quickest and most reliable method to setup neighbor lists. Only relations allowing handover are included in the neighbor lists. If you rely on the analysis to generate the neighbor lists for you, no user interaction is needed after having generated the lists.

You may override the automatic selection by moving cells between the *neighbor list* and a *waiting list* (still possible candidates), an *error list* (rejected candidates) and a list with *all other cells*.

An alternative, manual method to add neighbor relations is described in Add Individual Neighbor Relations on page 14-25.

The generated neighbor lists can be exported, and neighbor lists can be imported. See Import and Export of Neighbor Lists on page 12-2.

Generate WiMAX Neighbor Lists

Use this procedure to automatically generate lists of WiMAX cells neighboring other cells in a WiMAX network plan.

Prerequisites

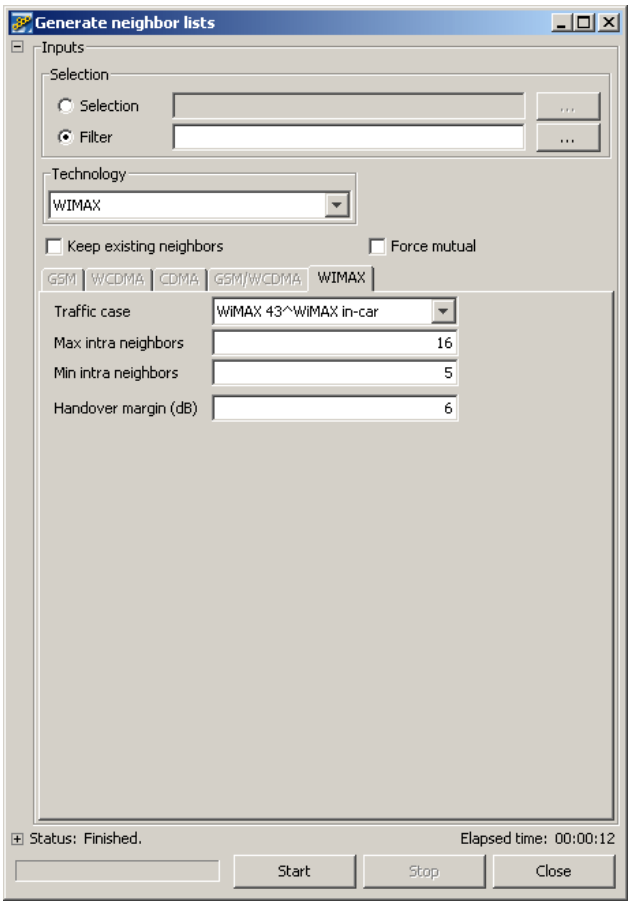
A *Received power per carrier matrix* must be available from the WiMAX Best Server Analysis.

Procedure

Follow these steps to generate neighbor lists for a GSM network plan:

1. Select **Analysis↗Neighbor list↗Optimize neighbor lists↗Generate neighbor lists** to display the **Generate neighbor lists** window.

2. In the technology list, select **WiMAX**. The parameters under the **WiMAX** tab appears:



3. Select a traffic case.
4. Modify the other parameters as required.
5. Click **Start** to generate the neighbor list results. The **Evaluate neighbor lists** window is displayed.
6. Proceed with Show Overview of WiMAX Neighbor Lists on page 14-19.

Fields on Window “Generate Neighbor Lists”

Field	Description
Technology	The network technology to use for list generation.
Keep existing neighbors	Already generated neighbors are kept in the list during generation of a new neighbor list.
Force mutual	Makes all neighbor relations on the list mutual.
Traffic case	The traffic case to analyze. A traffic case is a combination of a terminal type and a bearer. The bearer defines the carrier frequency to be used in the analysis.
Max intra neighbors	The maximum allowed amount of neighbors for a WiMAX cell. Range: 0 - 31.
Min intra neighbors	The minimum required amount of neighbors for a WiMAX cell. Range: 0 - 31.
Handover margin (dB)	Signal strength margin for handover.

Show Overview of WiMAX Neighbor Lists

Use this procedure to show an overview of automatically generated WiMAX neighbor lists.

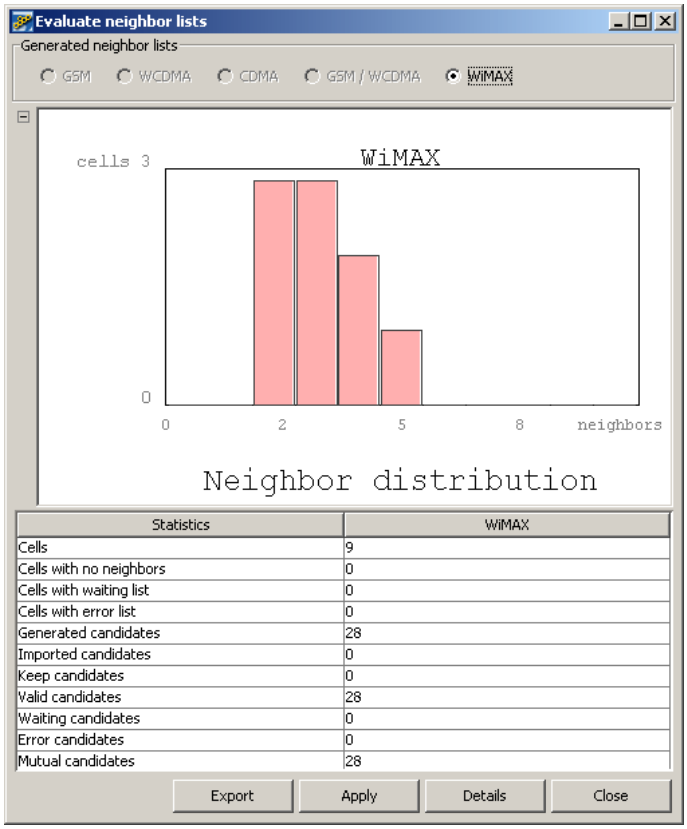
Prerequisites

Neighbors lists from Generate WiMAX Neighbor Lists on page 14-17 are available.

Procedure

Follow these steps to evaluate the neighbor analysis results:

1. Select **Analysis↗Neighbor list↗Evaluate neighbor lists.** A graph with neighbor distribution and a table with neighbor statistics are displayed, as in the example below:



2. To view the neighbor lists in detail, select **Details** and follow the instructions in View Details of WiMAX Neighbor Lists on page 14-21.
3. To override the automatic selection of neighbors, follow the instructions in Override Automatic Selection of Neighbor Cells on page 14-24.
4. To export the neighbor lists, follow the instructions in Import and Export of Neighbor Lists on page 12-2.
5. To preserve the neighbor lists, select **Apply**.

Fields on Window "Evaluate Neighbor Lists"

Field	Description
Generated neighbor lists	Selects the radio technology for which to display generated neighbor lists (if available).
Neighbor distribution chart	Histogram over neighbor distribution. The x axis displays the number of neighbors, the y axis the number of cells. In the example, there are 3 cells with 2 and 3 neighbors each, 2 cells with 4 neighbors and 1 cell with 5 neighbors.
(neighbor statistics)	The neighbor statistics of the analyzed traffic case: • Number of cells • Number of cells with no neighbors • Number of cells with waiting list • Number of cells with error list • Total number of generated candidates • Total number of imported candidates • Total number of keep candidates • Total number of valid candidates • Total number of waiting candidates • Total number of error candidates • Total number of mutual candidates
Export	Exports neighbor lists to a text file.
Apply	Applies the neighbor relations to the cell data.
Details	Displays details of the neighbor relations generated.

View Details of WiMAX Neighbor Lists

Use this procedure to view the neighbor lists of all analyzed cells. The **Neighbor list details** window displays a list of all analyzed cells and the neighbors found for each analyzed cell, together with the overlap percentage and status of the neighbor relation.

Prerequisites

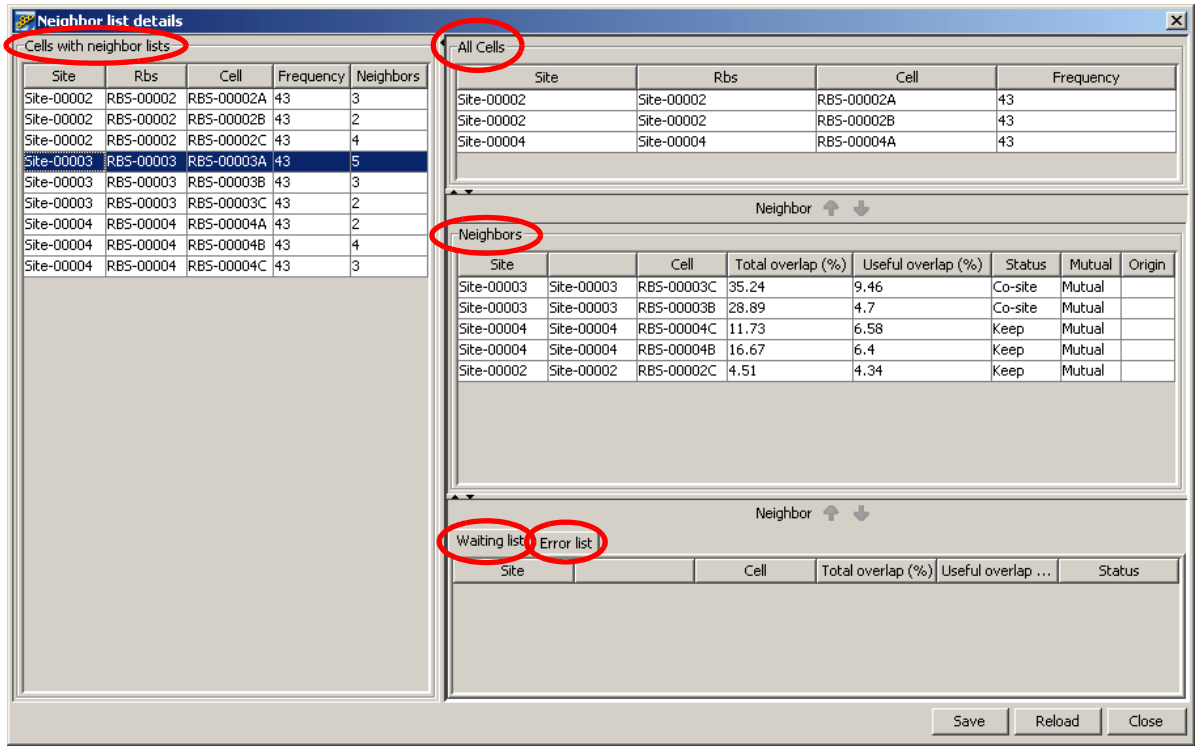
Neighbors lists from Generate WiMAX Neighbor Lists on page 14-17 are available.

Procedure

Follow these steps to view the neighbor analysis results:

1. Select **Analysis↗Neighbor list↗Evaluate neighbor lists.** A graph with neighbor distribution and a table with neighbor statistics are displayed, see Show Overview of WiMAX Neighbor Lists on page 14-19.

2. Select **Details**. The **Neighbor list details** window is displayed as in the following example:


Neighbor list details
Cells with neighbor lists
Site Rbs Cell Frequency Neighbors
Site-00002 RBS-00002 RBS-00002A 43 3
Site-00002 RBS-00002 RBS-00002B 43 2
Site-00002 RBS-00002 RBS-00002C 43 4
Site-00003 RBS-00003 RBS-00003A 43 5
Site-00003 RBS-00003 RBS-00003B 43 3
Site-00003 RBS-00003 RBS-00003C 43 2
Site-00004 RBS-00004 RBS-00004A 43 2
Site-00004 RBS-00004 RBS-00004B 43 4
Site-00004 RBS-00004 RBS-00004C 43 3
All Cells
Site Rbs Cell Frequency
Site-00002 Site-00002 RBS-00002A 43
Site-00002 Site-00002 RBS-00002B 43
Site-00004 Site-00004 RBS-00004A 43
Neighbor
Neighbors
Site Cell Total overlap (%) Useful overlap (%) Status Mutual Origin
Site-00003 Site-00003 RBS-00003C 35.24 9.46 Co-site Mutual
Site-00003 Site-00003 RBS-00003B 28.89 4.7 Co-site Mutual
Site-00004 Site-00004 RBS-00004C 11.73 6.58 Keep Mutual
Site-00004 Site-00004 RBS-00004B 16.67 6.4 Keep Mutual
Site-00002 Site-00002 RBS-00002C 4.51 4.34 Keep Mutual
Neighbor
Waiting list
Error list
Site Cell Total overlap (%) Useful overlap ... Status
Save
Reload
Close

3. Analyze the results. The contents of the lists are described in Fields on Window "Neighbor List Details" on page 14-23.
4. To manually modify the automatically generated neighbor lists, follow the instructions in Override Automatic Selection of Neighbor Cells on page 14-24.
5. To overwrite the displayed neighbor lists with a saved neighbor list from the calculation results directory, click **Reload**.
6. To save the neighbor lists to the calculations results directory, click **Save**.

Note: *To save the neighbor lists persistently you must return to the previous window by clicking **Close**, and in that window click **Apply**.*

Fields on Window "Neighbor List Details"

Field	Description	
Cells with neighbor lists	All cells analyzed by WiMAX Neighbor Analysis, listed on the left side of the window. One cell at a time can be selected from this list, and the result is shown in the right side of the window.	
Relations to the cell selected from the list of **Cells with neighbor lists**:		
All cells	The other cells, not yet included in any of the other lists: **Neighbors**, **Waiting list**, **Error list**.	
Neighbors	Neighbor cells. This list initially includes the neighbor cells found to allow handover according to the WiMAX Neighbor Analysis. Any cell may be placed on the neighbor list, even cells not approved by the WiMAX Neighbor Analysis. Each cell in the list is described by among other the following parameters:	
	Total overlap (%)	Overlap of cell neighbor area with predicted signal strength, expressed as percentages of the cells' best server area. A region of overlap is defined for every pair of cells.
	Useful overlap (%)	The area where the neighbor cells' signal strength is within the handover margin, expressed as percentage of the cells' best server area.
	Status	Possible values: • Co-site - Automatically generated relation, neighbor cell located in same RBS as the analyzed cell • Added by user - Relation manually added by the user after generating the neighbor list. • Generated - New neighbor with useful overlap • No useful overlap - New neighbor without useful overlap
	Mutual	Possible values: • Mutual • Non-mutual relation - The neighbor cell has no neighbor relation to the analyzed cell. Handovers can only be done from the analyzed cell to the neighbor cell.
	Origin	The reason for the relation being in this list. Possible values: • (empty) - The relation is automatically generated • Added by user - Relation manually added by the user after generating the neighbor list

Field	Description	
Waiting list	"Observation" list of cells that might be neighbor cells. This list is initially empty. Any cell may be placed on the waiting list, even cells that were not found to be possible neighbor cells in the WiMAX Neighbor Analysis. Each cell in the list is described by among other the following parameters:	
	Status	Possible values: • No useful overlap - None of the cells are within the handover margin. Candidates with no overlap within the handover margin are placed on the waiting list when the target cell's neighbor list has the minimum required neighbor relations. • Exceeded list length - Candidates on the waiting list are there because the list of qualified neighbors reached the maximum allowed.
Error list	Cells rejected as neighbor cells. This list is initially empty. Any cell may be placed on the waiting list, even possible neighbor cells found in the WiMAX Neighbor Analysis. Each cell in the list is described by among other the following parameters:	
	Status	Possible values: • Deleted by user - Neighbor relation removed from the neighbor list • Wanted by reverse neighbor - The target cell's neighbor list has the maximum neighbor relations. Force mutual cannot be achieved due to maximum neighbors.
·,	Moves the selected cell to the list above or below the current list.	
Save	Saves the neighbor list to the calculation results directory. You can reload the saved list at a later time.	
Reload	Reloads a saved neighbor list from the calculation results directory.	

Override Automatic Selection of Neighbor Cells

Use this procedure to override automatically generated neighbor lists.

Prerequisites

Neighbor lists are generated and viewed, see View Details of WiMAX Neighbor Lists on page 14-21.

Procedure

Follow the instructions below to override automatically generated neighbor lists.

To add a cell to the neighbor list, do as follows:

1. Highlight the cell in any of the lists **All cells, Waiting list, Error list**.
2. Use the ↑ or ↓ arrows to move the cell to the **Neighbors** list.

Note: *The added cell might not be capable of performing handover to/from the analyzed cell.*

To remove a cell from the neighbor list, do as follows:

1. Highlight the cell in the **Neighbors** list.
2. Use the ↑ or ↓ arrows to move the cell to any of the other lists: **All cells, Waiting list, Error list**.

Add Individual Neighbor Relations

Use this procedure to manually add individual neighbor cell relations to WiMAX cells.

Note: *The neighbor relations created with this procedure are not evaluated from a handover perspective.*

Prerequisites

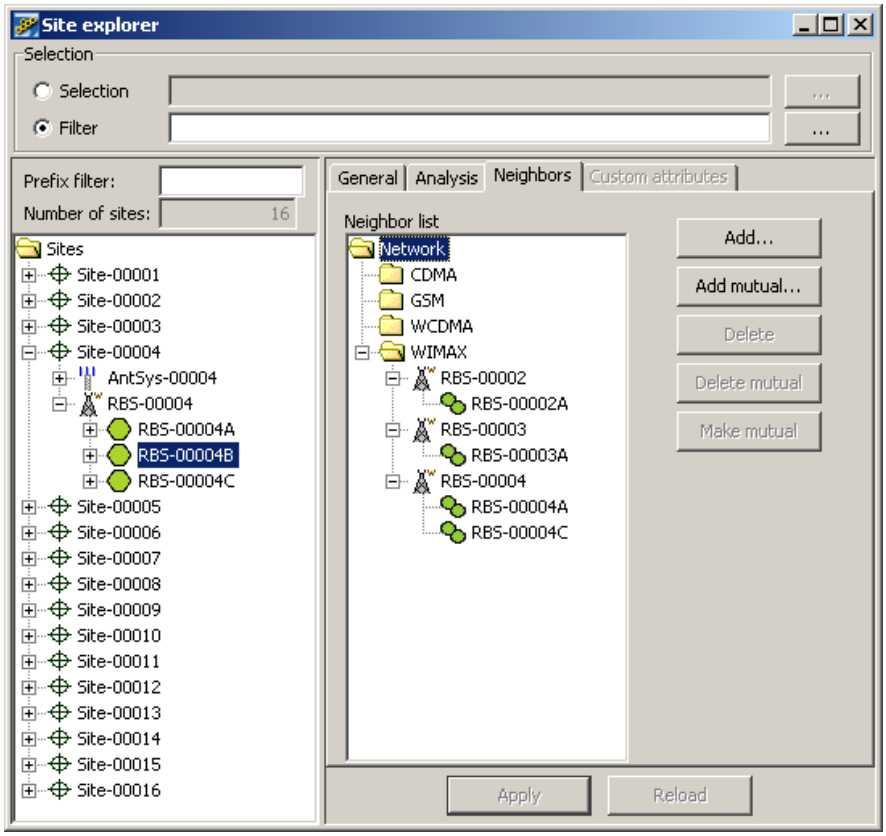
WiMAX cells are defined, see Add WiMAX Cell to an RBS on page 10-8.

Procedure

Follow these steps to manually add neighbors to cells:

1. Using the **Site explorer** or the **WiMAX RBS explorer**, select the cell(s) for which to add neighbors.

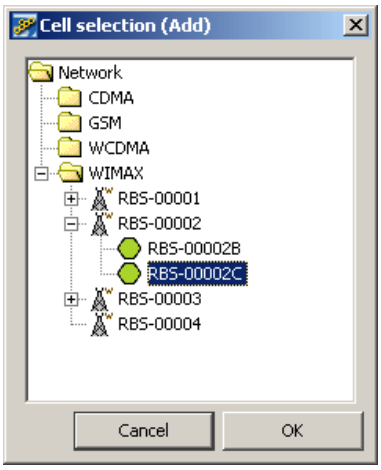
2. Select the **Neighbors** tab to display the **Neighbor list** window, as in the following example:



3. Highlight the **WiMAX** folder and select **Add**. The **Cell selection (Add)** window with possible neighbor cells are displayed.

Note: *To instead add mutual relations, select **Add mutual**. A similar window named **Cell selection (Add mutual)** is opened. The procedure for adding mutual relations is the same as for one-way relations.*

4. Highlight the cell(s) to add as neighbors, as in the example below:



5. In the RBS hierarchy displayed for the technology, select the RBS and cell to add as a neighbor relation.
6. Click **OK**. The neighbor list in the explorer window is updated with the new relation(s).

Fields on Window "Neighbor List"

Field	Description
Neighbor list	Shows the neighbors for a cell, organized by technology and then by RBS. Mutual cell relationships are displayed with a double green cell icon. Non-mutual relationships are displayed with a green/white cell icon. The list indicates when the relation is mutual, meaning that the origin cell is also included on the neighbor list of the target cell.
Add...	Displays the **Cell selection (Add)** window for adding neighbor cells to the highlighted cell. Makes the cell relationship non-mutual.
Add mutual...	Displays the **Cell selection (Add mutual)** window for adding a mutual cell neighbor relationship.
Delete	Deletes a neighbor relationship from a cell.
Delete mutual	Deletes a mutual relationship from the original cell and its neighbor.
Make mutual	Makes a cell relationship mutual between two cells.

Show Neighbor Cells on Map Display

You can show the neighbor cells of a selected cell on the map display, either by color marking the neighbor cells, or by drawing lines to the neighbor cells.

Neighbor Display by Colors

The serving cell is always red. The neighbor cell colors are configurable. Mutual relations cannot be displayed with color, in the serving cell.

Neighbor Display by Lines

Neighbor display by lines, describing mutual neighbor information by red/black and Neighbor cell by a configurable color. One serving cell indicates the Neighbor cell(s) by one line for each Neighbor cell.

The line between the serving cell and the neighbor cell contains information of mutual/non mutual neighbor cell. The line is divided in the middle, to represent the mutuality at the first part from the serving cell to the middle and to represent frequency band at the rest of the line.

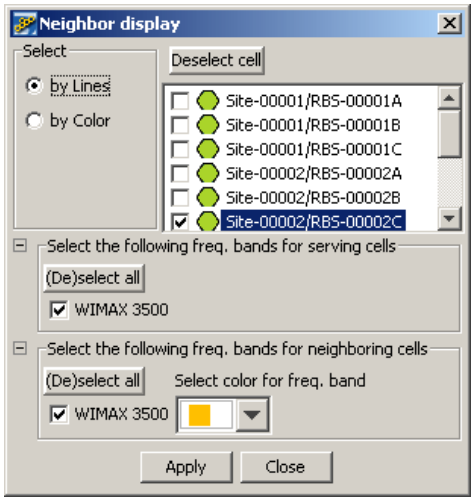
The color of the first half of the line from the serving cell carries the information (red or black) for non-mutual respective mutual neighboring cells.

When finding more than one neighbor cell at a cell position, each cell position is considered to be on a line, separated by a small distance within the cell symbol, perpendicular to the neighbor line connecting serving and neighbor cell.

Procedure

Follow these steps to view neighbor cells on the map display:

1. To show neighbor cells on the map display, select **Analysis↗Neighbor display**. The **Neighbor display** window appears:



2. Select a cell for which to show the neighbors.
3. Select the color to use for showing neighbor relations or marking neighbor cells.

4. To show the neighbor relations as lines, select **by Lines** and click **Apply**.
5. To color mark the neighbor cells, select **by Color** and click **Apply.**

Fields on Window "Neighbor display"

Field	Description
Select by lines	Map display window shows neighbor relations by lines connecting cells/sectors.
Select by color	Map display window shows neighbor cells by colors.
Frequency bands for serving cells	Frequency bands of the serving cells to display.
Frequency bands for neighboring cells	Frequency bands of the neighboring cells to display.

Troubleshooting Analysis Results

Only Cosited Cells as Neighbors

Sometimes a cell does not get any other neighbor than its cosited cells from the WiMAX Neighbor Analysis. The explanation is that the cell has no best server area, since it is completely overlapped by other, stronger cells.

You can solve this problem in different ways:

- If the cell appears as a non-mutual neighbor to surrounding cells, select the **Force mutual** box in the **Generate neighbor lists** window, or use the **Make mutual** button for the surrounding cells in the **GSM RBS explorer**.
- Enhance the coverage of the cell by increasing its power.
- Use a higher resolution in the pathloss prediction to obtain a more visible coverage of the cell.

Interference at Cell Borders Reduced by PUSC

When a network is planned with only one frequency, the interference becomes high near the cell borders. It will then be necessary to use PUSC (Partial Use of Sub-Carriers) mode. The percentage of the frame used for PUSC and the number of subcarrier sets are important for the performance. Higher values give better C/(I+N) values and user data rates at the cost of lower total cell capacity. TEMS CellPlanner automatically decides where to use PUSC or FUSC, but you have to try out the parameter setting that gives the best trade-off between cell capacity and C/(I+N).

15
WiMAX Plots

This chapter describes the plots from analysis of a WiMAX network plan.

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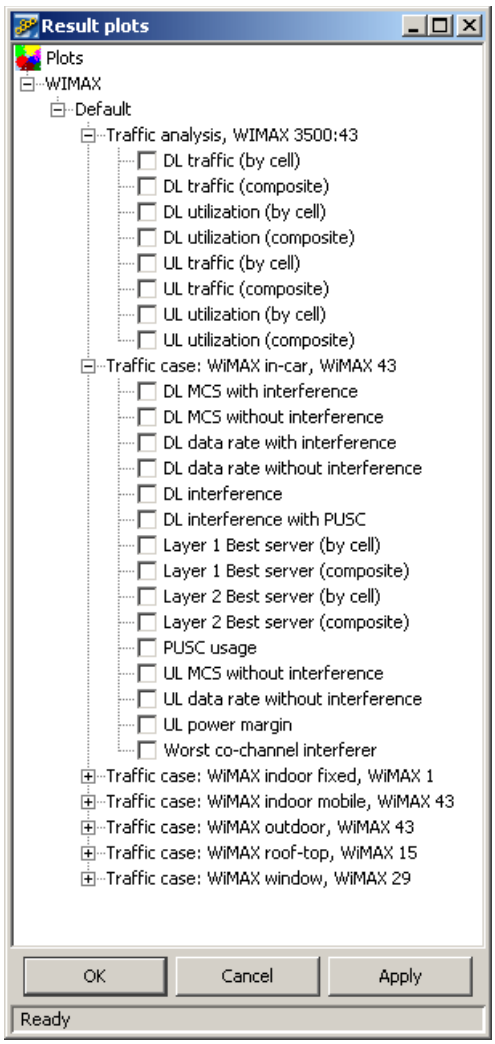
About WiMAX Plots

For generic information about plots, read chapter *Plots* in the *TEMS CellPlanner Common Features User's Guide.*

The WiMAX result plots selection window opened from **Analysis↗Result plots** might look as in the following example:



WiMAX Best Server Plots

The result from Calculate WiMAX Best Server may be displayed as plots, color coded for every bin.

The following best server plots may be generated per traffic case:

- Layer N Best server (by cell or composite)
  The DL coverage of the very best, 2nd best, 3rd best server and so on.
- DL MCS without interference
- DL data rate without interference
- UL MCS without interference
- UL data rate without interference
- UL power margin

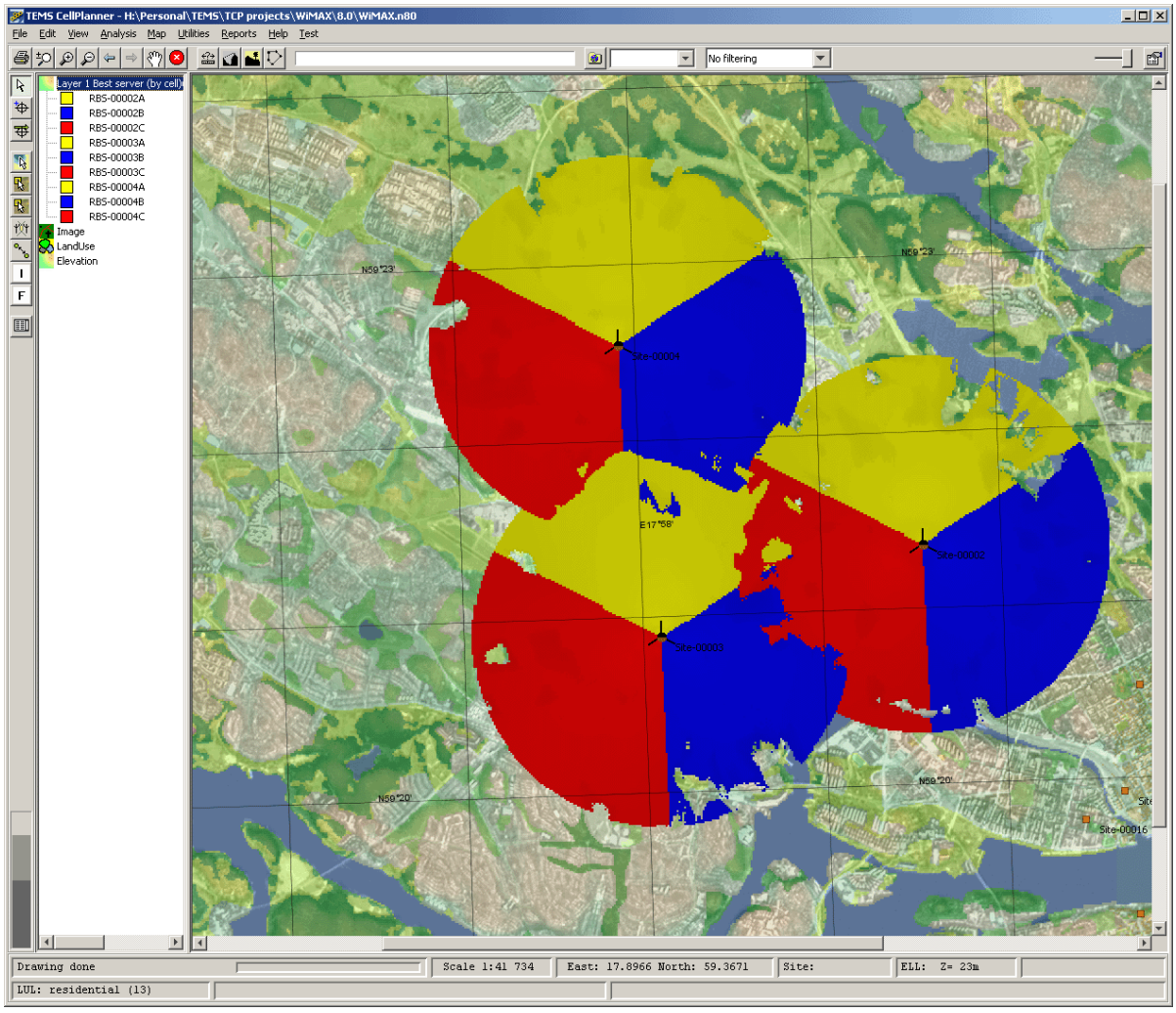
The subsequent pages describe and exemplify the available best server plots.

Layer N Best Server (by Cell)

This plot display the downlink coverage of the very best, 2nd best, 3rd best serving cell and so on, depending on the value of the parameter **Depth of best server list**.

The identity of the best serving cell is displayed on the status bar together with the received signal strength, measured in dBm.

The figure below shows an example of a best server plot (by cell):

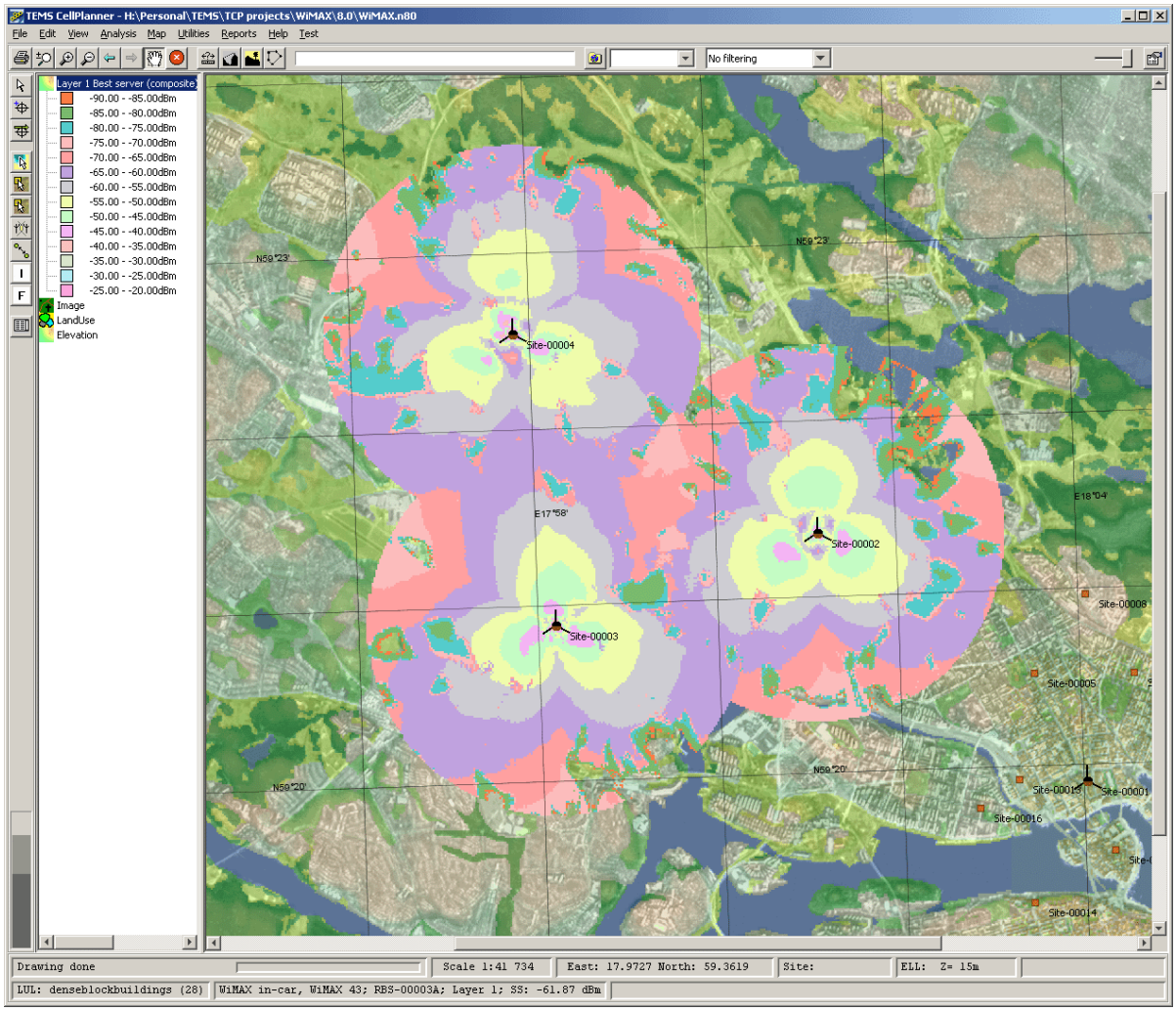


Layer N Best Server (Composite)

This plot display the downlink composite coverage of the very best, 2nd best, 3rd best serving cell and so on, depending on the value of the parameter **Depth of best server list**.

The received signal strength is displayed on the status bar together with the identity of the best serving cell.

The figure below shows an example of a best server plot (composite):

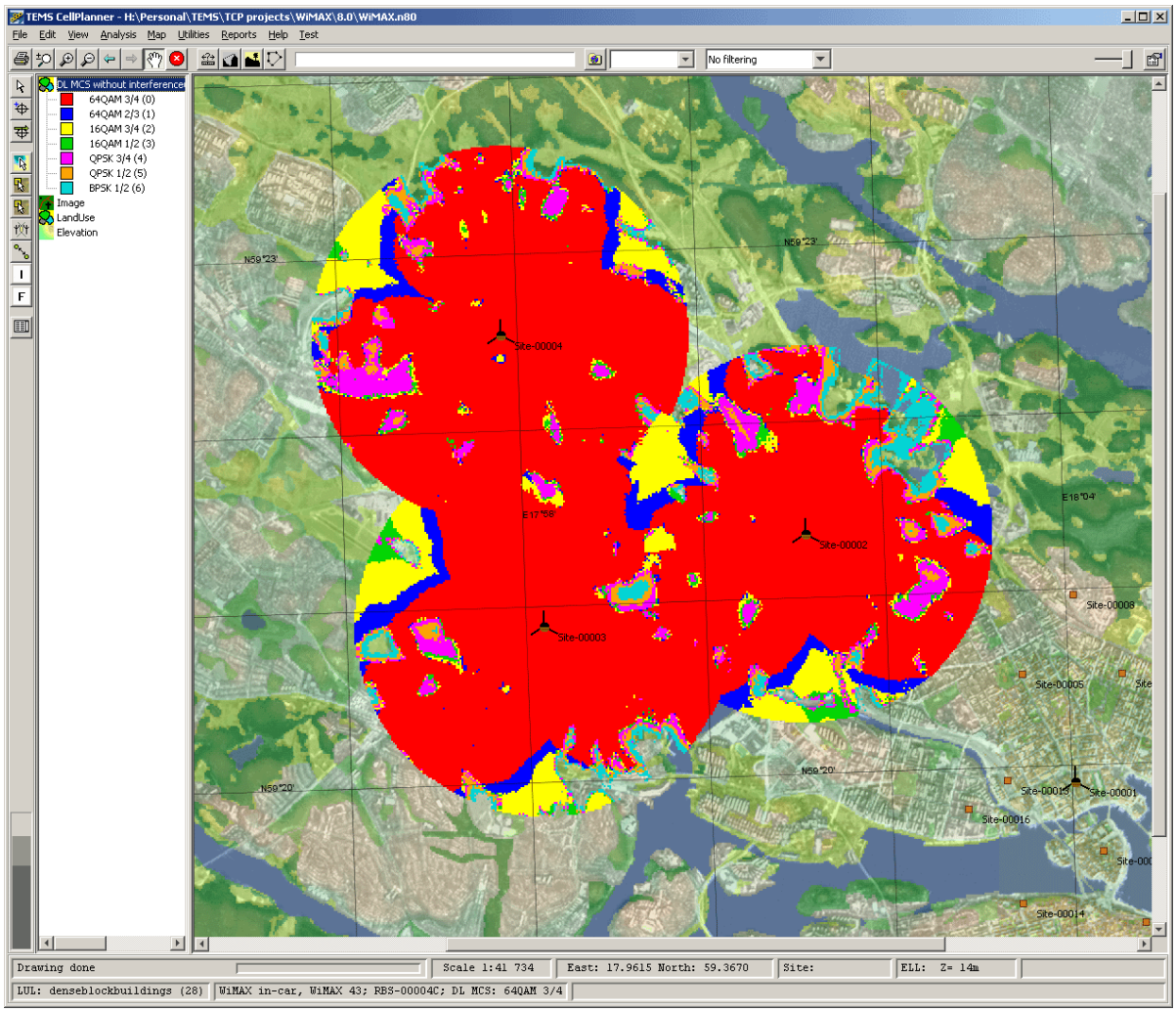


DL MCS Without Interference

This plot displays the coverage of the best possible downlink MCSs.

The best DL MCS is displayed on the status bar together with the identity of the serving cell.

The figure below shows an example of a DL MCS plot without interference:



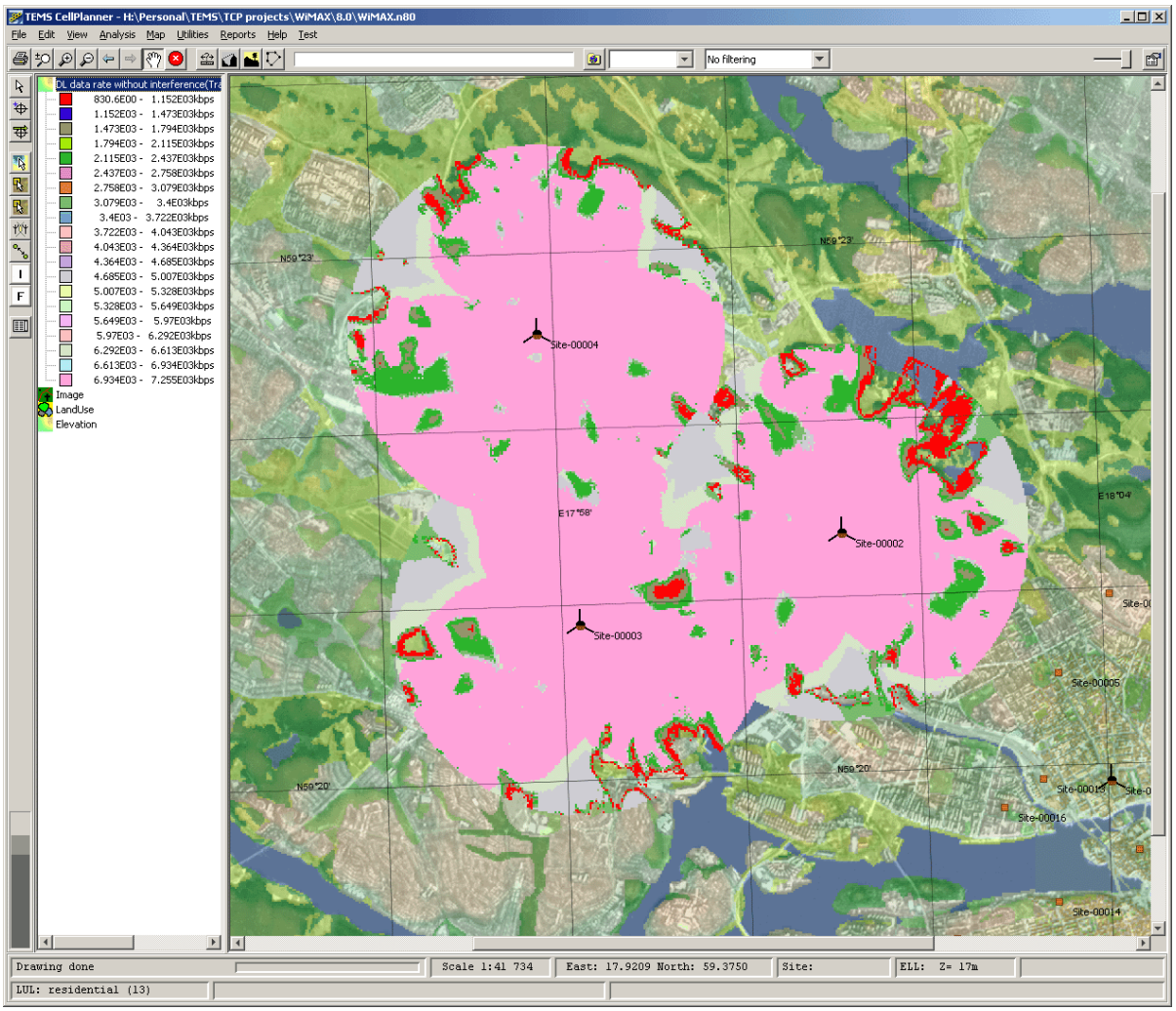
DL Data Rate Without Interference

This plot displays the achieved downlink data rate for the full carrier bandwidth, using the best DL MCS.

The achieved downlink data rate of a terminal is the number of bits per second of traffic data received by the terminal. Only pure traffic data is counted, signalling overhead is excluded. *Full carrier bandwidth* means that the terminal listens to all sub-carriers of its downlink carrier(s).

The DL data rate is displayed on the status bar together with the identity of the serving cell.

The figure below shows an example of a DL data rate plot without interference:



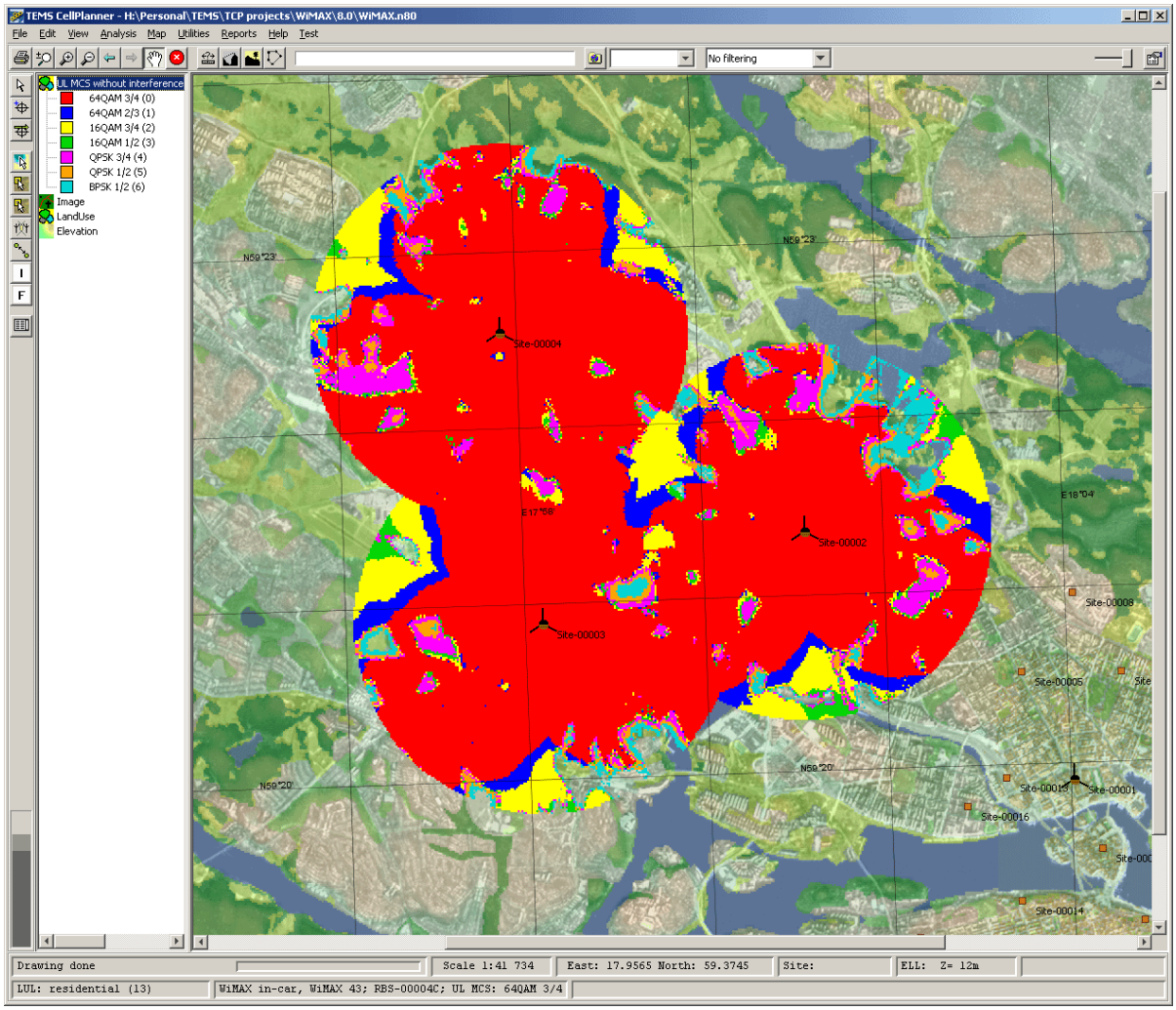
To view the best DL MCS, select the plot DL MCS Without Interference.

UL MCS Without Interference

This plot displays the coverage of the best possible uplink MCSs.

The best UL MCS is displayed on the status bar together with the identity of the serving cell.

The figure below shows an example of an UL MCS plot without interference:



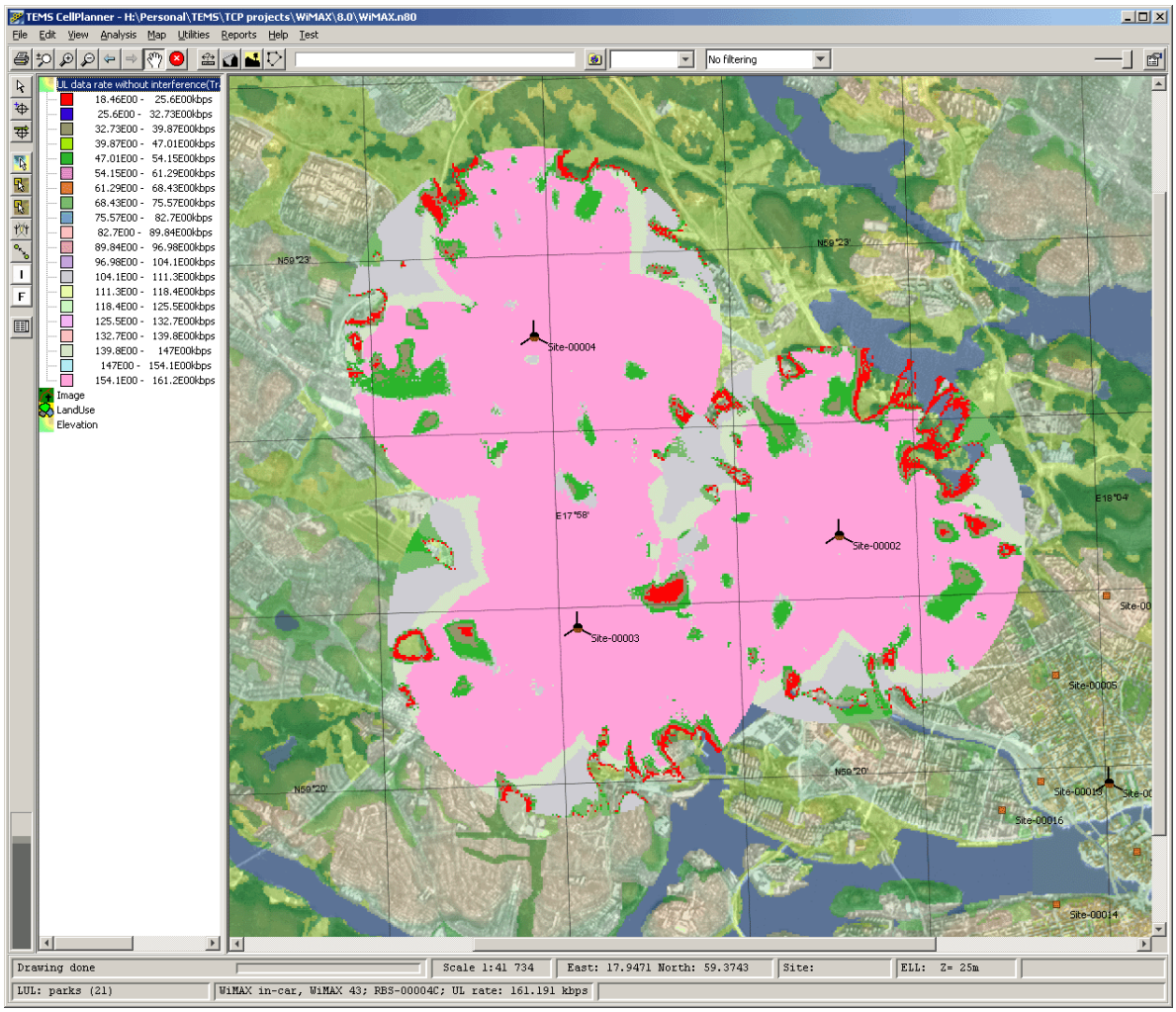
UL Data Rate Without Interference

This plot displays the achieved uplink data rate for the terminal type when the best UL MCS is used.

The achieved uplink data rate of a terminal is the number of bits per second of traffic data transmitted on all UL sub-channels of the terminal. The UL sub-channels are defined by the carrier mapping of the bearer(s). Only pure traffic data is counted, signalling overhead is excluded.

The UL data rate is displayed on the status bar together with the identity of the serving cell.

The figure below shows an example of an UL data rate plot without interference:



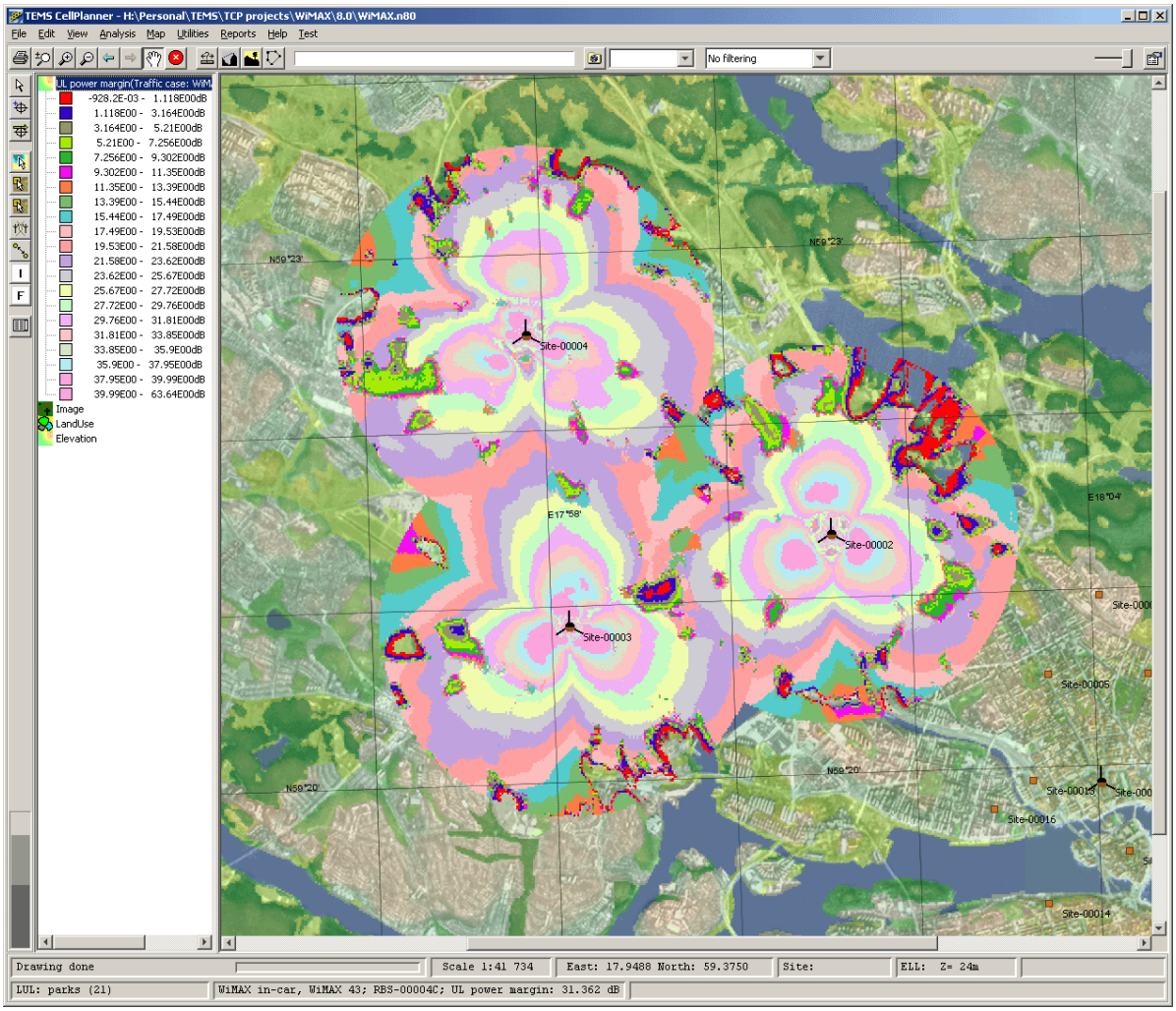
To view the best UL MCS, select the plot UL MCS Without Interference.

UL Power Margin

This plot displays the uplink coverage for various Tx power margins - measured in dB - of the terminal when transmitting to the best serving cell.

The Tx power margin is displayed on the status bar together with the identity of the best serving cell.

The figure below shows an example of an UL power margin plot:



WiMAX Interference Plots

The result from Calculate WiMAX Interference may be displayed as plots, color coded for every bin.

The following interference plots may be generated per traffic case:

- PUSC usage
- Downlink interference
- Downlink interference with PUSC
- Worst co-channel interferer
- Downlink MCS with interference
- Downlink data rate with interference

The subsequent pages describe and exemplify the available interference plots.

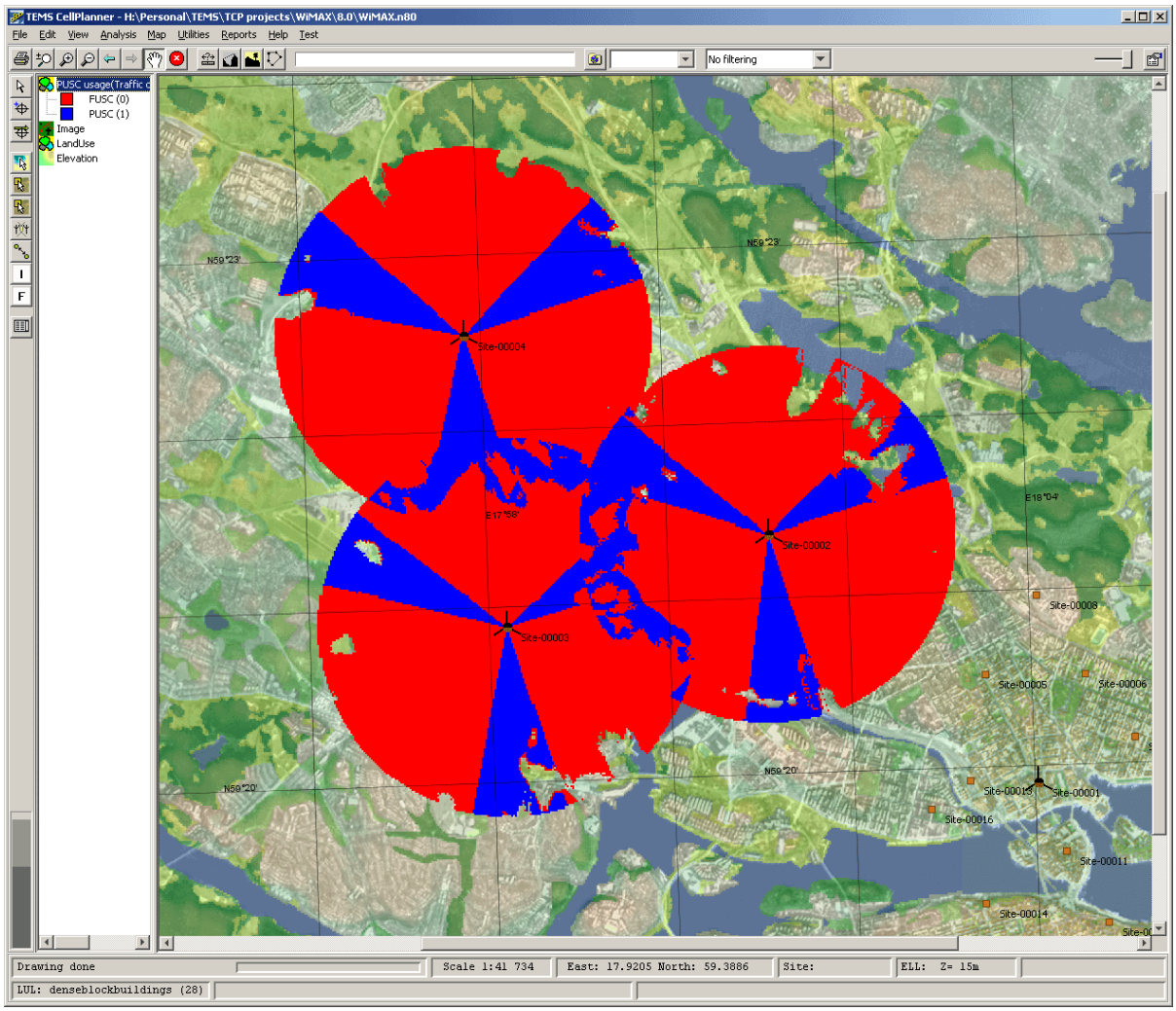
PUSC Usage

This plot displays the areas where PUSC or FUSC mode is used on the radio channel of the serving cell.

If PUSC is not enabled, the plot will show FUSC usage everywhere.

The PUSC and FUSC mode areas are displayed on the status bar together with the identity of the serving cell and the channel assignment.

The figure below shows an example of PUSC usage plot:

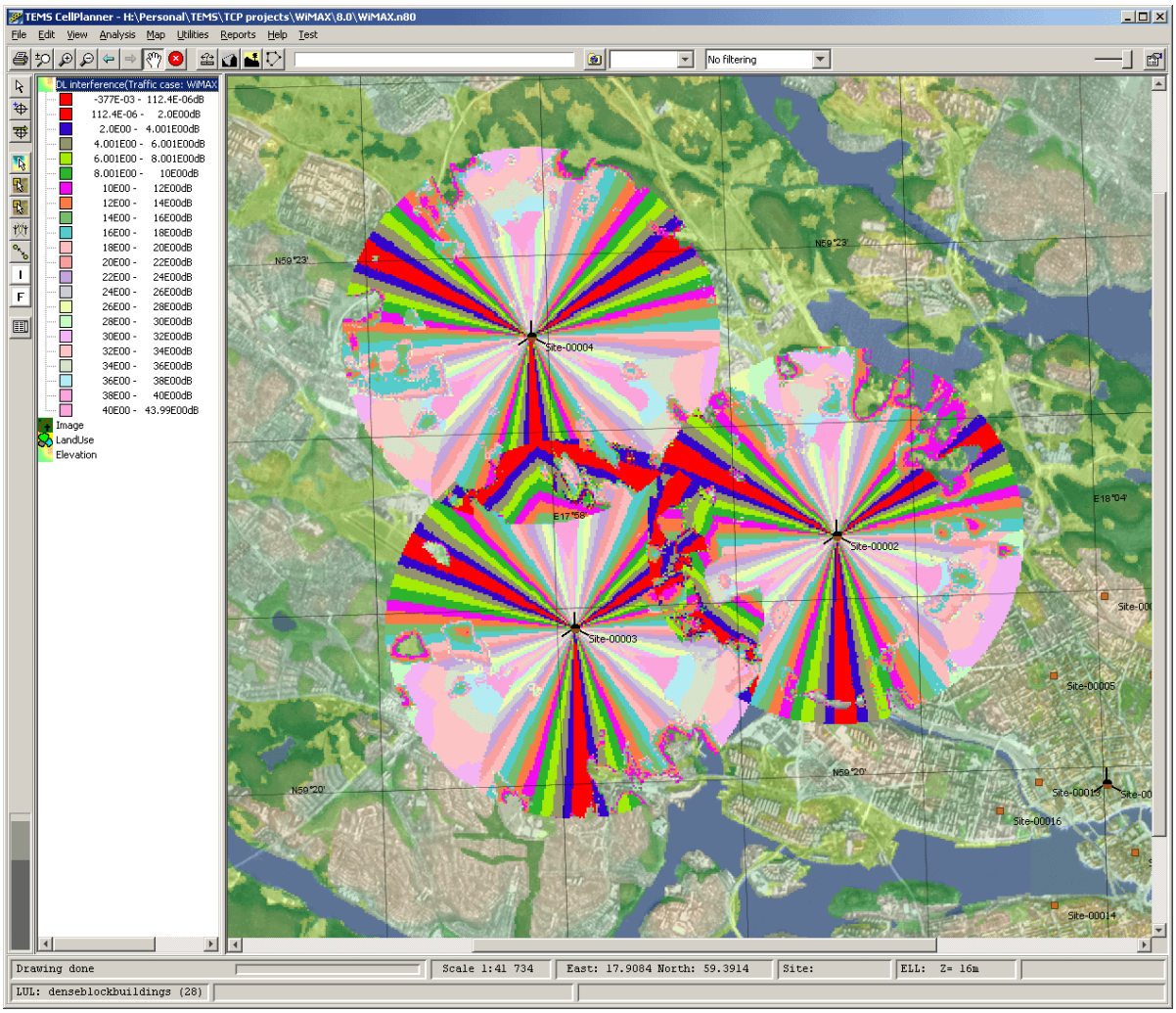


DL Interference

This plot displays the C/(I+N) value in dB on the radio channel of the serving cell, without using PUSC.

The C/(I+N) value is displayed on the status together with the identity of the serving cell and the bearer.

The figure below shows an example of a DL interference plot:



DL Interference With PUSC

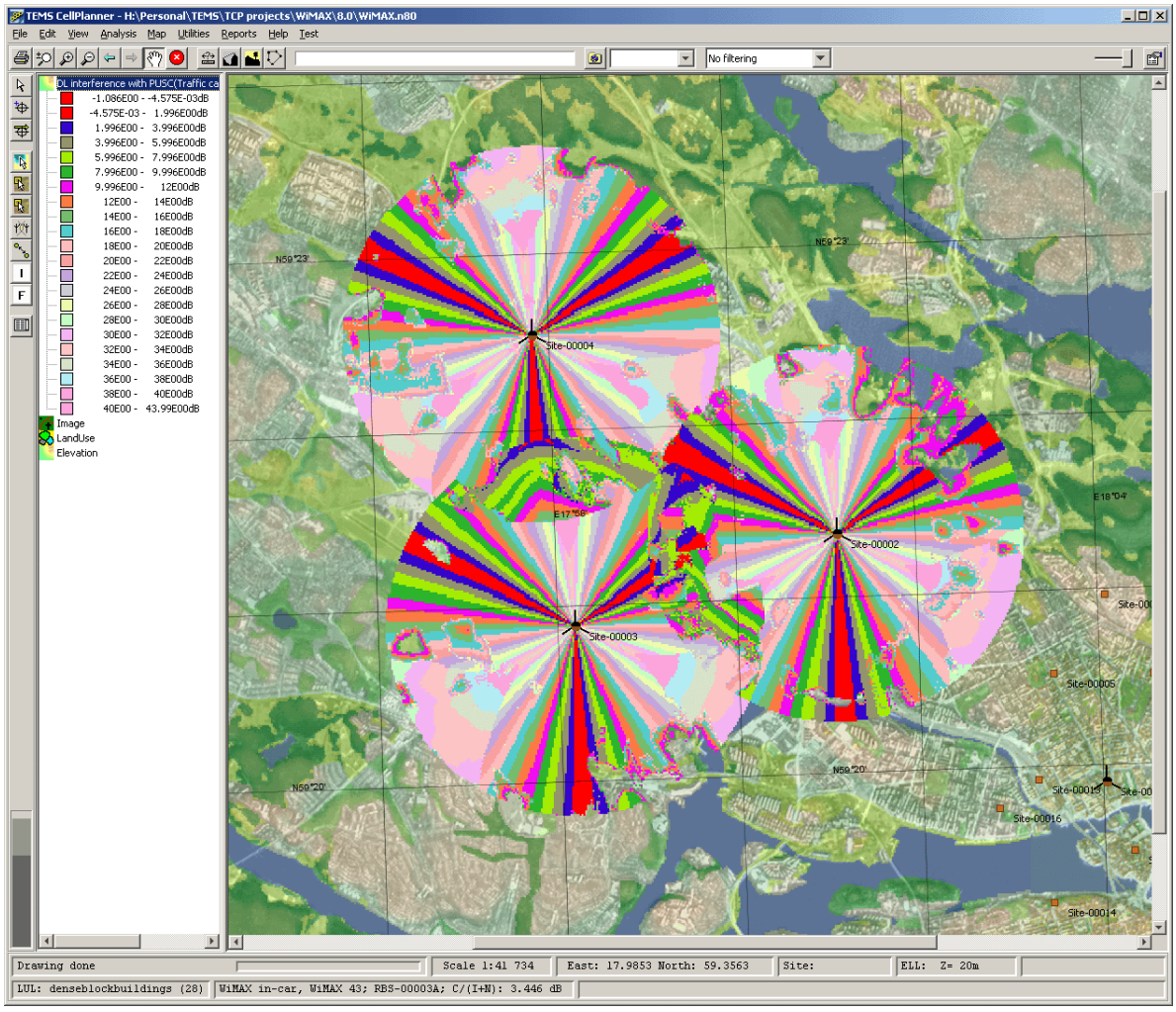
This plot displays the C/(I+N) in dB on the radio channel of the serving cell.

The C(I+N) for PUSC or FUSC mode is shown in areas where PUSC or FUSC is used, respectively.

For co-sited cells, that is, cells located in the same RBS as the serving cell, the interference in PUSC areas is reduced by the PUSC interference rejection factor, see Configure WiMAX Project Parameters on page 5-5. For other interferers, the interference is inversely proportional to the number of subcarrier sets used in PUSC mode.

The C/(I+N) for PUSC and FUSC is displayed on the status bar, together with the identity of the serving cell and the bearer.

The figure below shows an example of a DL interference plot with PUSC:

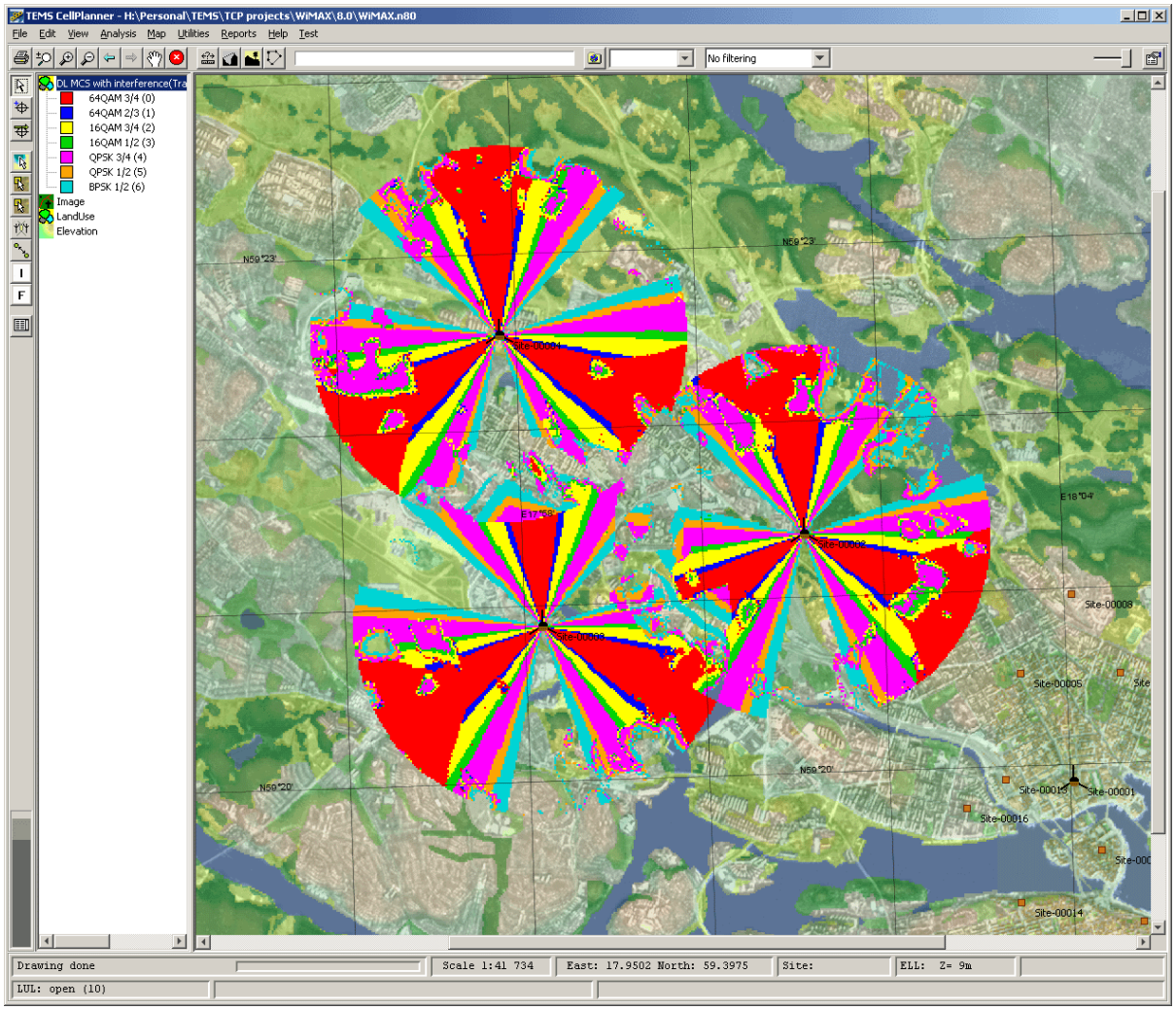


DL MCS With Interference

This plot displays the identity of the best MCS that can be used for the calculated PUSC/FUSC C/(I+N) on the radio channel of the serving cell.

The MCS is displayed on the status bar together with the identity of the serving cell.

The figure below shows an example of a DL MCS plot with interference:



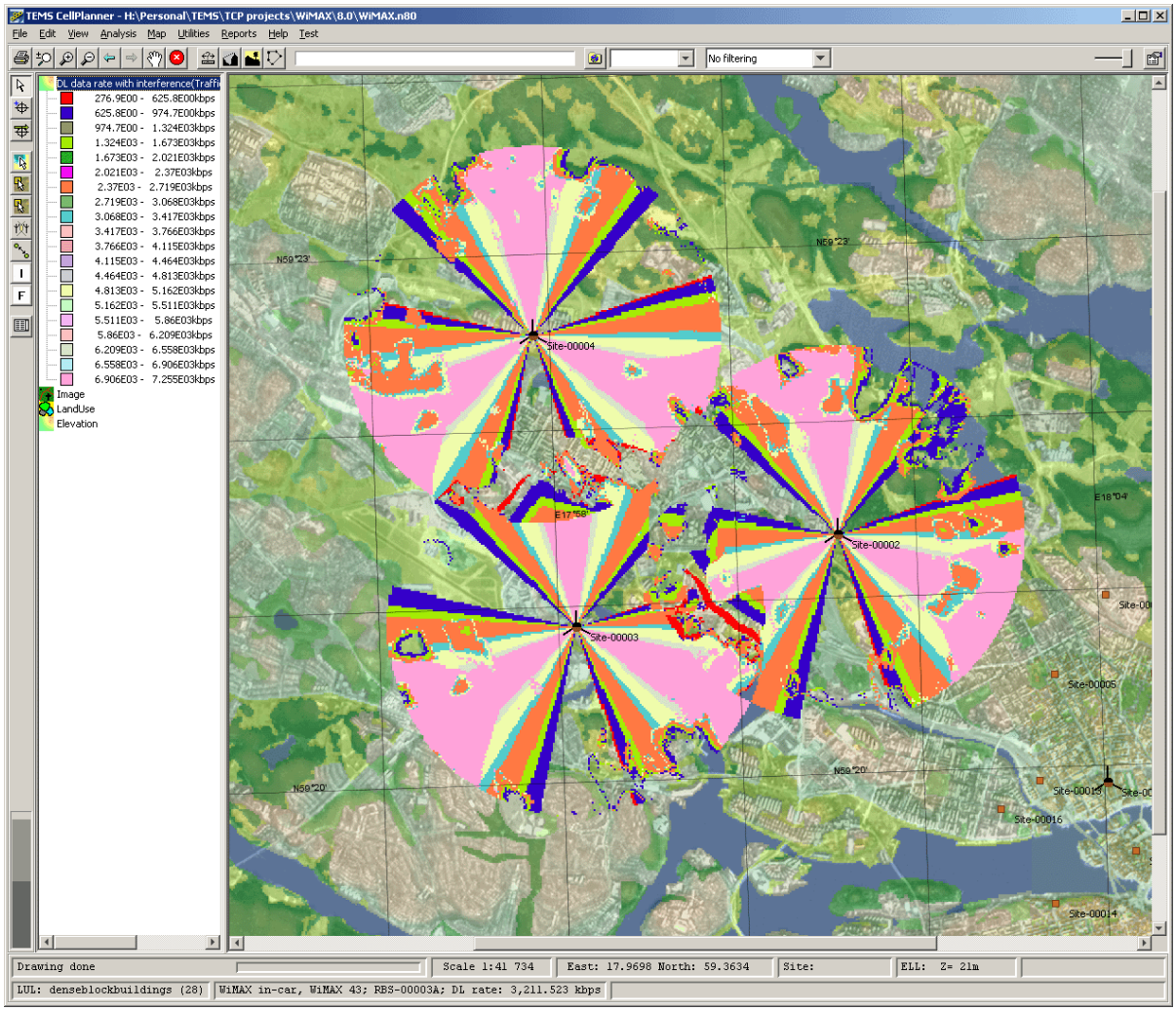
DL Data Rate With Interference

This plot displays the achieved data rate for the full carrier bandwidth when the best MCS is used, and with the calculated PUSC/FUSC C/(I+N) on the radio channel of the serving cell.

The achieved downlink data rate of a terminal is the number of bits per second of traffic data received by the terminal. Only pure traffics data is counted, signalling overhead is excluded. *Full carrier bandwidth* means that the terminal listens to all sub-carriers of its downlink carrier(s).

The data rate is displayed on the status bar, together with the identity of the serving cell.

The figure below shows an example of a DL data rate plot with interference:



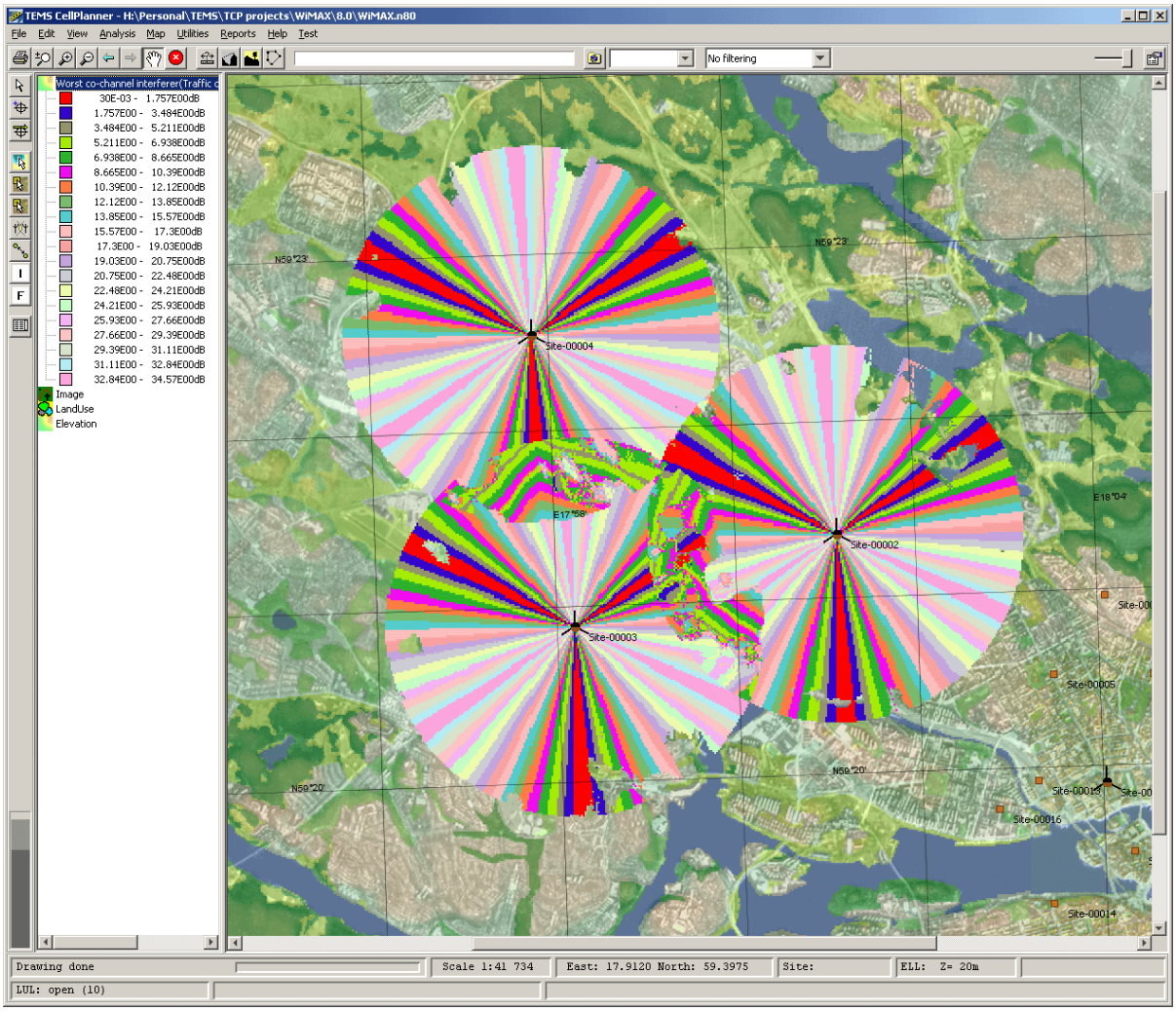
Worst Co-channel Interferer

This plot displays the C/I in dB generated by the worst co-channel interferer on the radio channel of the serving cell. The worst co-channel interferer is the cell giving the highest interference contribution in the bin.

For co-sited cells, that is, cells located in the same RBS as the serving cell, the interference in PUSC areas is reduced by the PUSC interference rejection factor, see Configure WiMAX Project Parameters on page 5-5. For other interferers, the interference is inversely proportional to the number of subcarrier sets used in PUSC mode.

The C/I value is displayed on the status bar, together with the bearer and the identity of the worst co-channel interferer.

The figure below shows an example of a worst co-channel interferer plot:



WiMAX Traffic Performance Plots

The result from Calculate WiMAX Traffic Performance can be displayed as plots, color coded for all bins served by the cell.

The following traffic performance plots may be generated per traffic case:

- DL traffic (by cell or composite)
- DL utilization (by cell or composite)
- UL traffic (by cell or composite)
- UL utilization (by cell or composite)

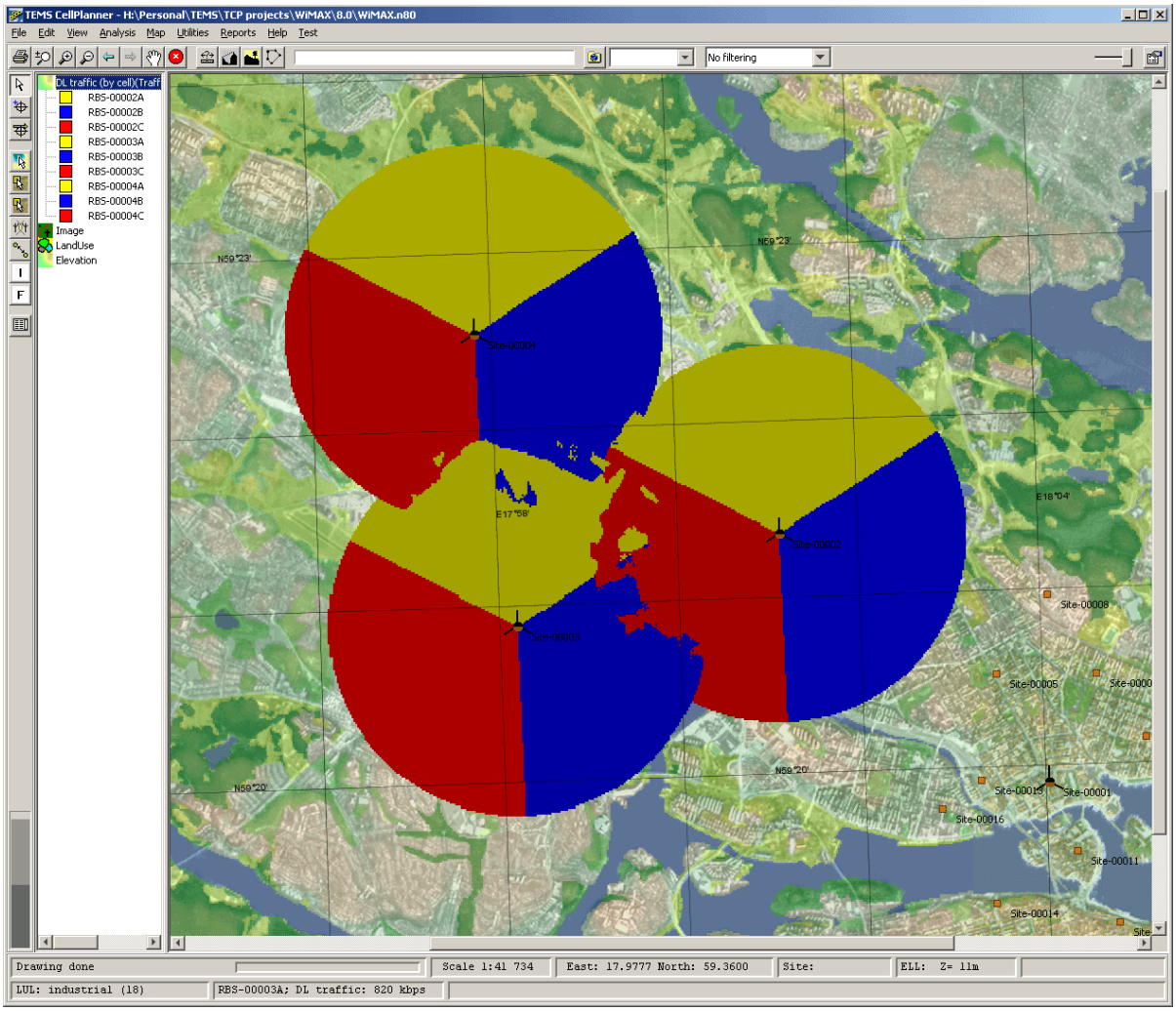
The plots show the calculated amount of DL and UL traffic in the cell, for the selected traffic case(s).

The subsequent pages describe and exemplify the available traffic performance plots.

DL Traffic (by Cell)

The identity of the serving cell is displayed on the status bar, together with the total DL traffic in kbps of the serving cell.

The figure below shows an example of a DL traffic plot (by cell):

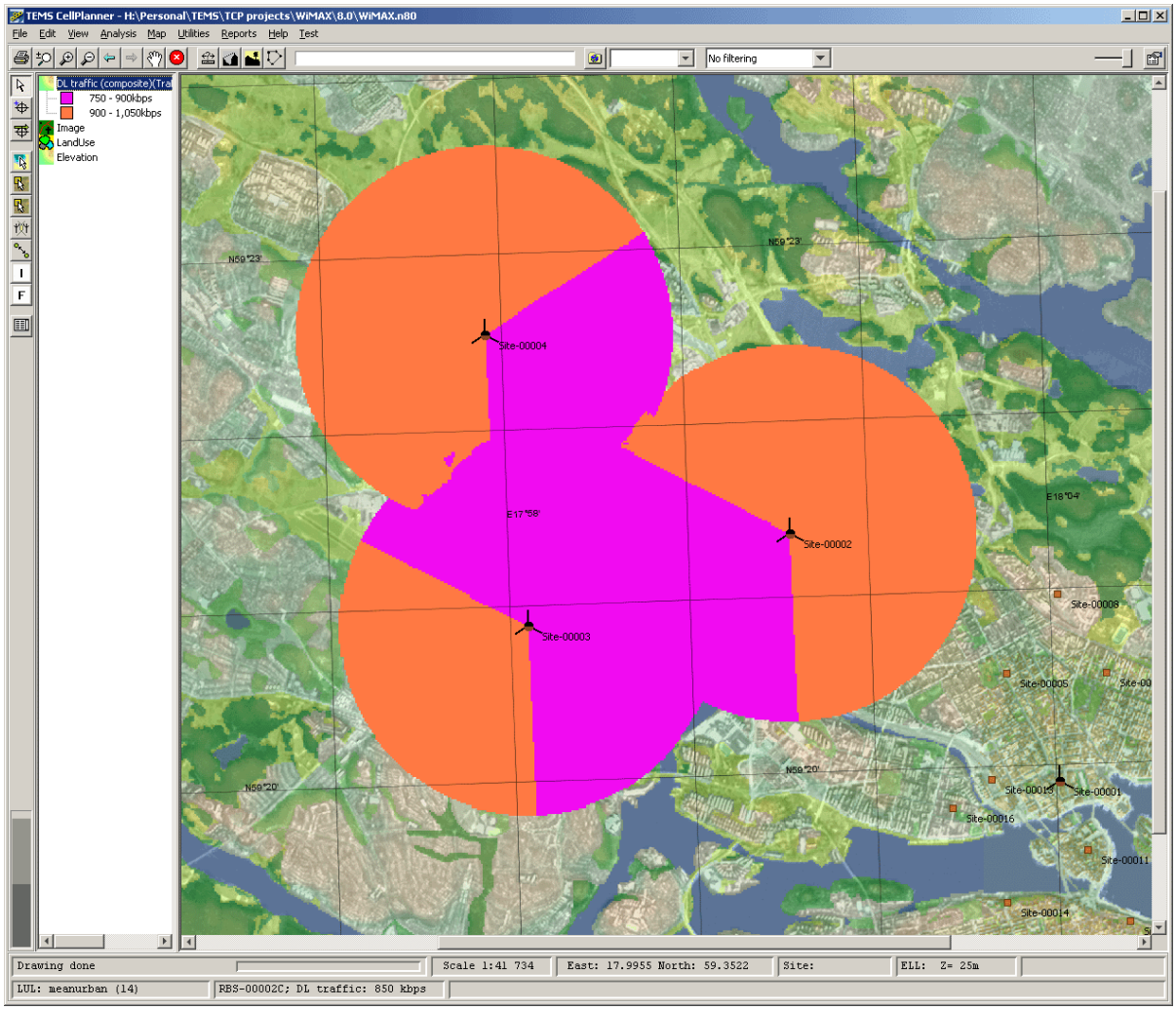


DL Traffic (Composite)

This plot displays the total downlink traffic from the serving cell, measure in kbps.

The total DL traffic in kbps of the serving cell is displayed on the status bar, together with the identity of the serving cell.

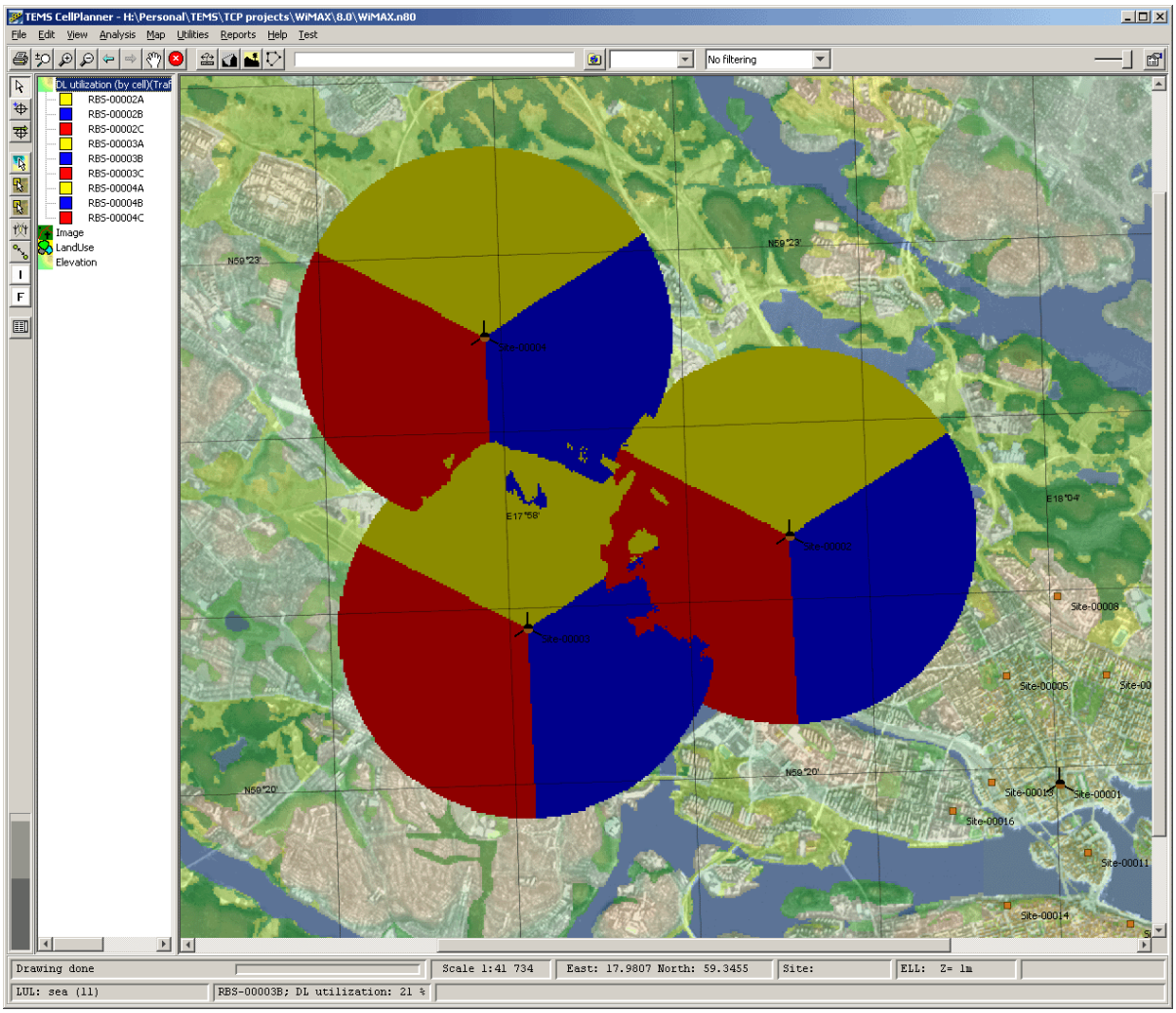
The figure below shows an example of a composite DL traffic plot:



DL Utilization (by Cell)

The identity of the serving cell is displayed on the status bar, together with the used percentage of the DL capacity of the serving cell when each connected terminal uses its best possible MCS.

The figure below shows an example of a DL utilization plot (by cell):



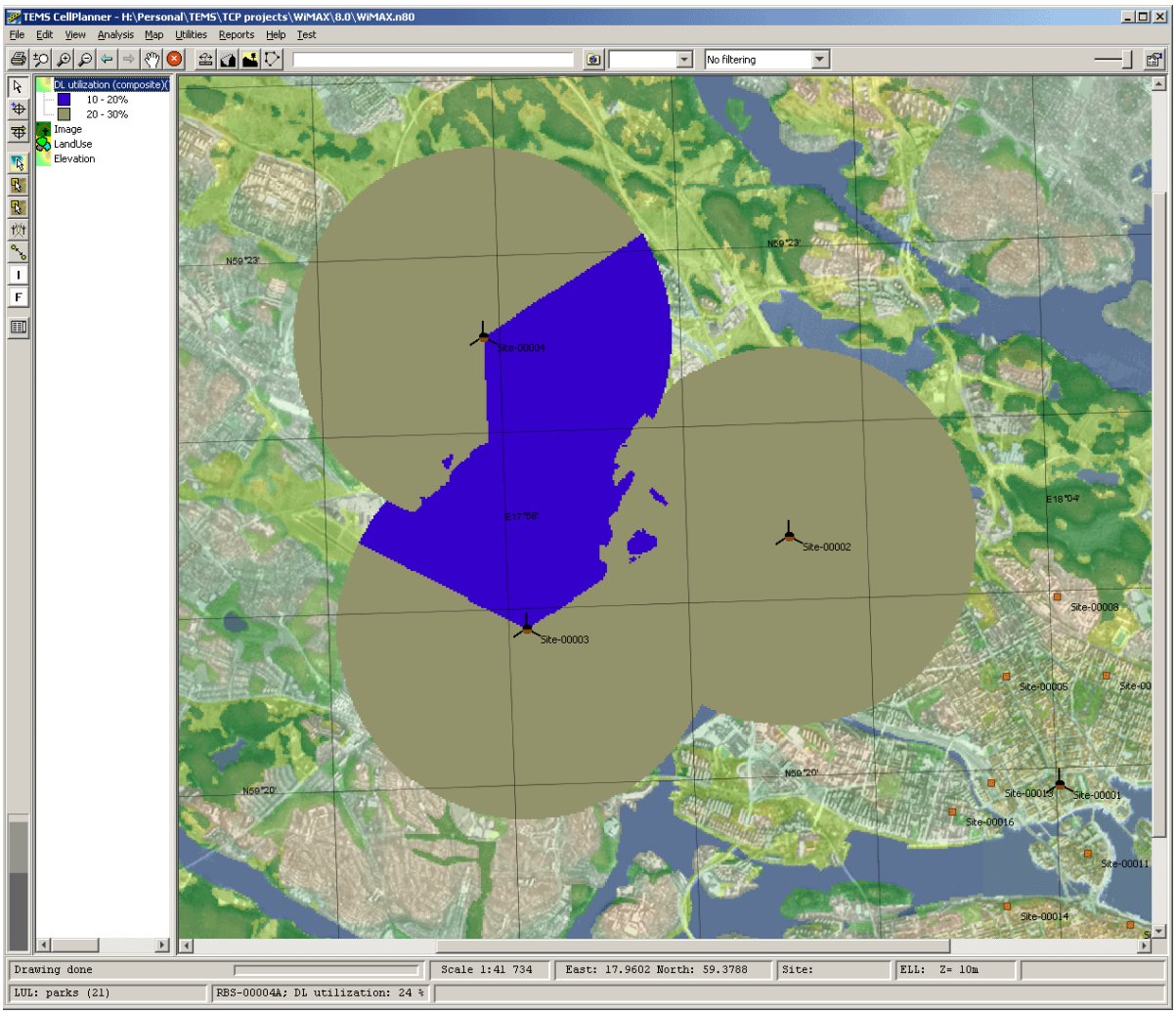
DL Utilization (Composite)

This plot displays the used percentage of the downlink capacity of the serving cell, when each connected terminal uses its best possible MCS.

100% utilization of a cell's downlink capacity is reached when all downlink traffic sub-carriers are used all the time. Only pure traffic data is counted, signalling overhead is excluded.

The DL utilization is displayed on the status bar, together with the identity of the serving cell.

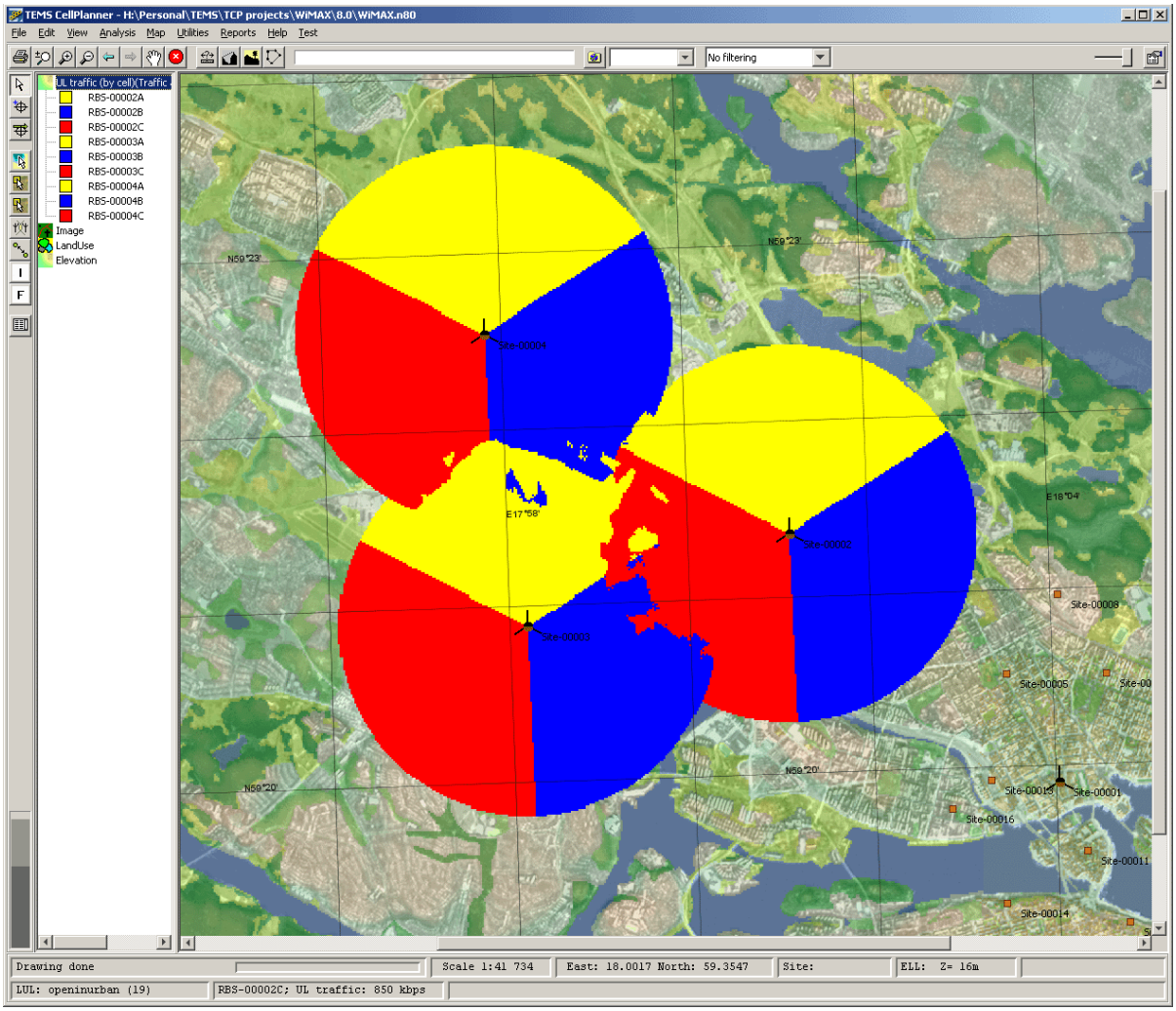
The figure below shows an example of a composite DL utilization plot:



UL Traffic (by Cell)

The identity of the serving cell is displayed on the status bar, together with the total UL traffic in kbps of the serving cell.

The figure below shows an example of an UL traffic plot (by cell):

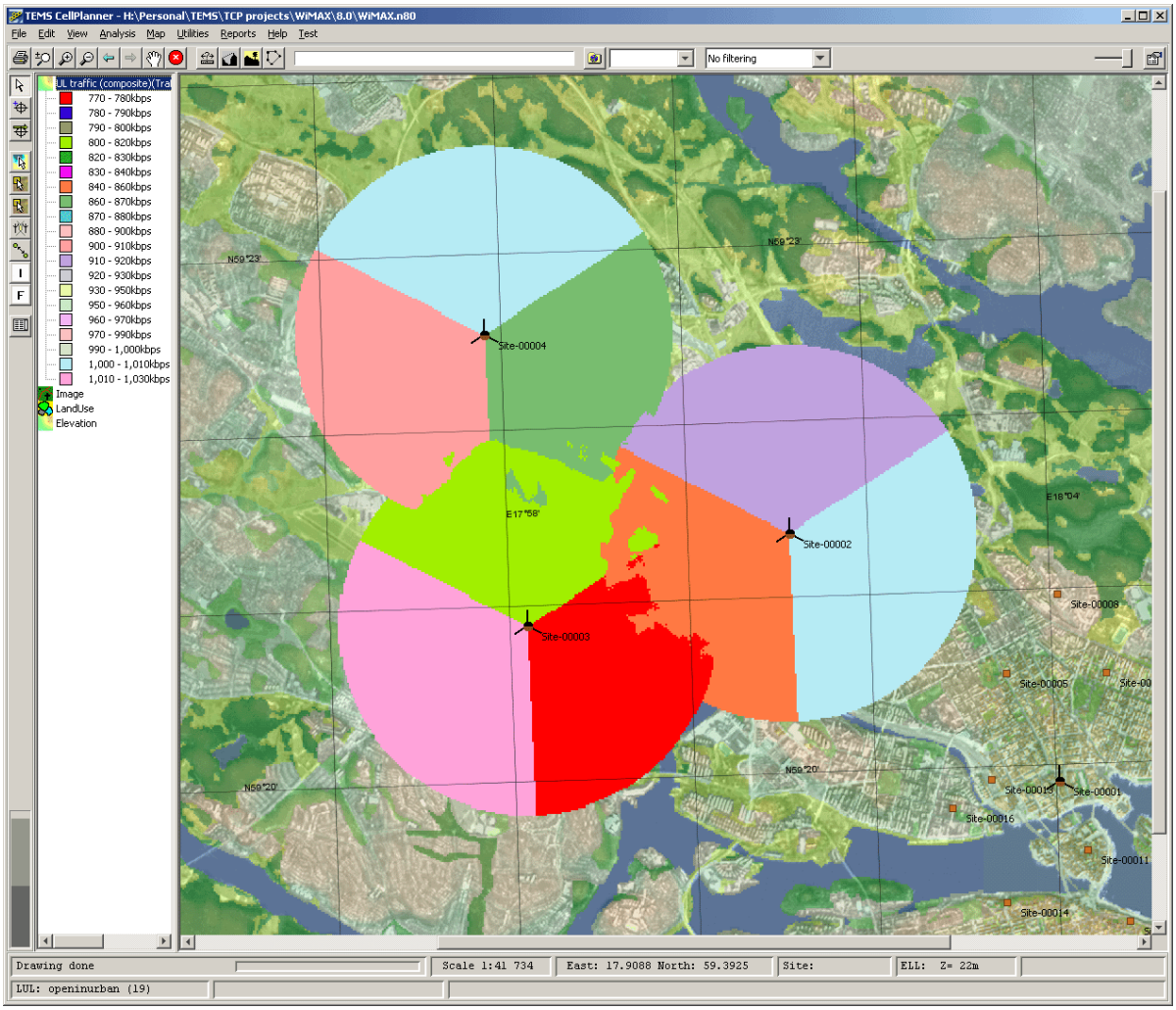


UL Traffic (Composite)

This plot displays the total uplink traffic to the serving cell, measured in kbps.

The UL traffic is displayed on the status bar, together with the identity of the serving cell.

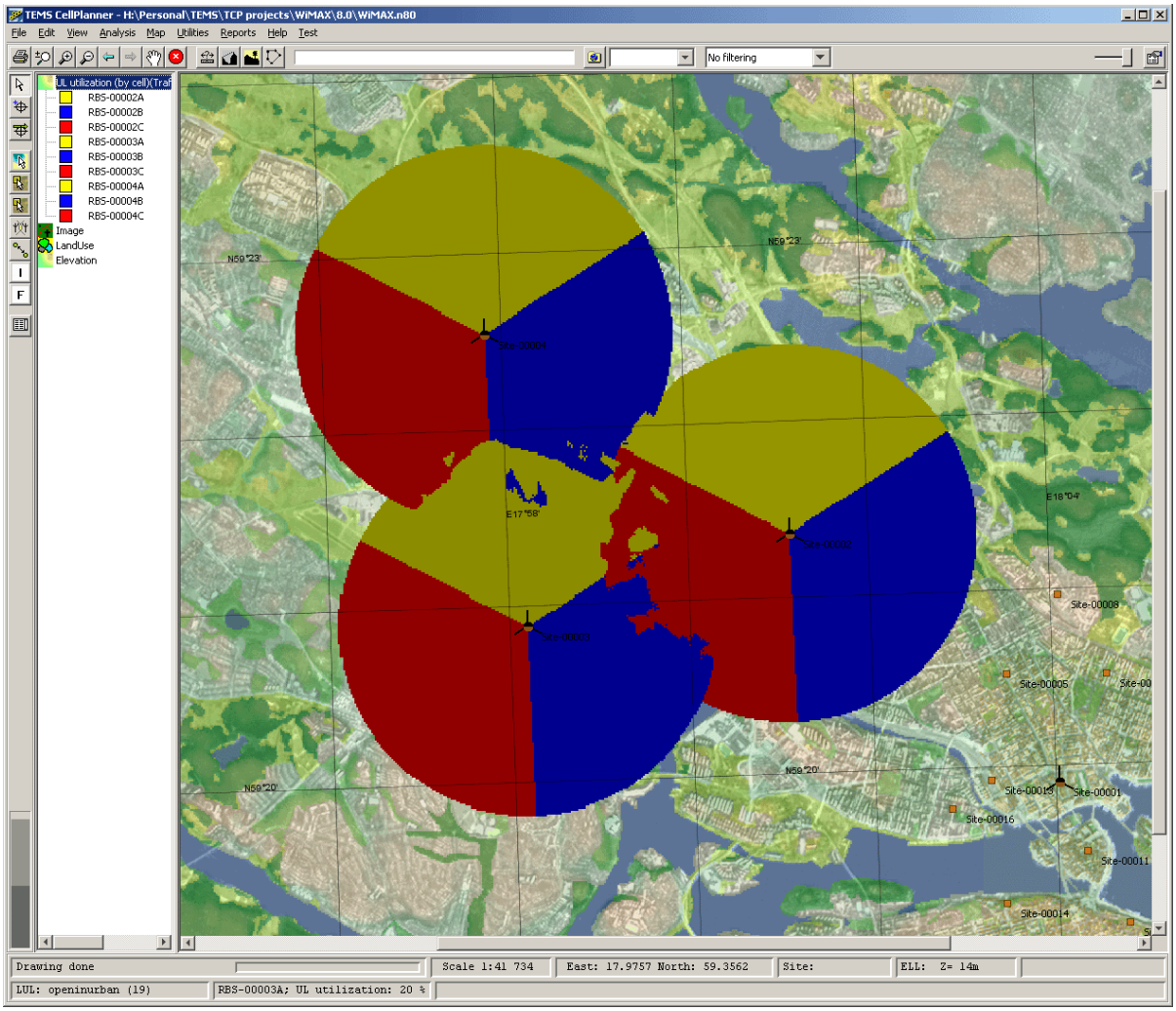
The figure below shows an example of an UL traffic plot (composite):



UL Utilization (by Cell)

The identity of the serving cell is displayed on the status bar, together with the used percentage of the UL capacity of the serving cell when the best MCS is used.

The figure below shows an example of an UL utilization plot (by cell):



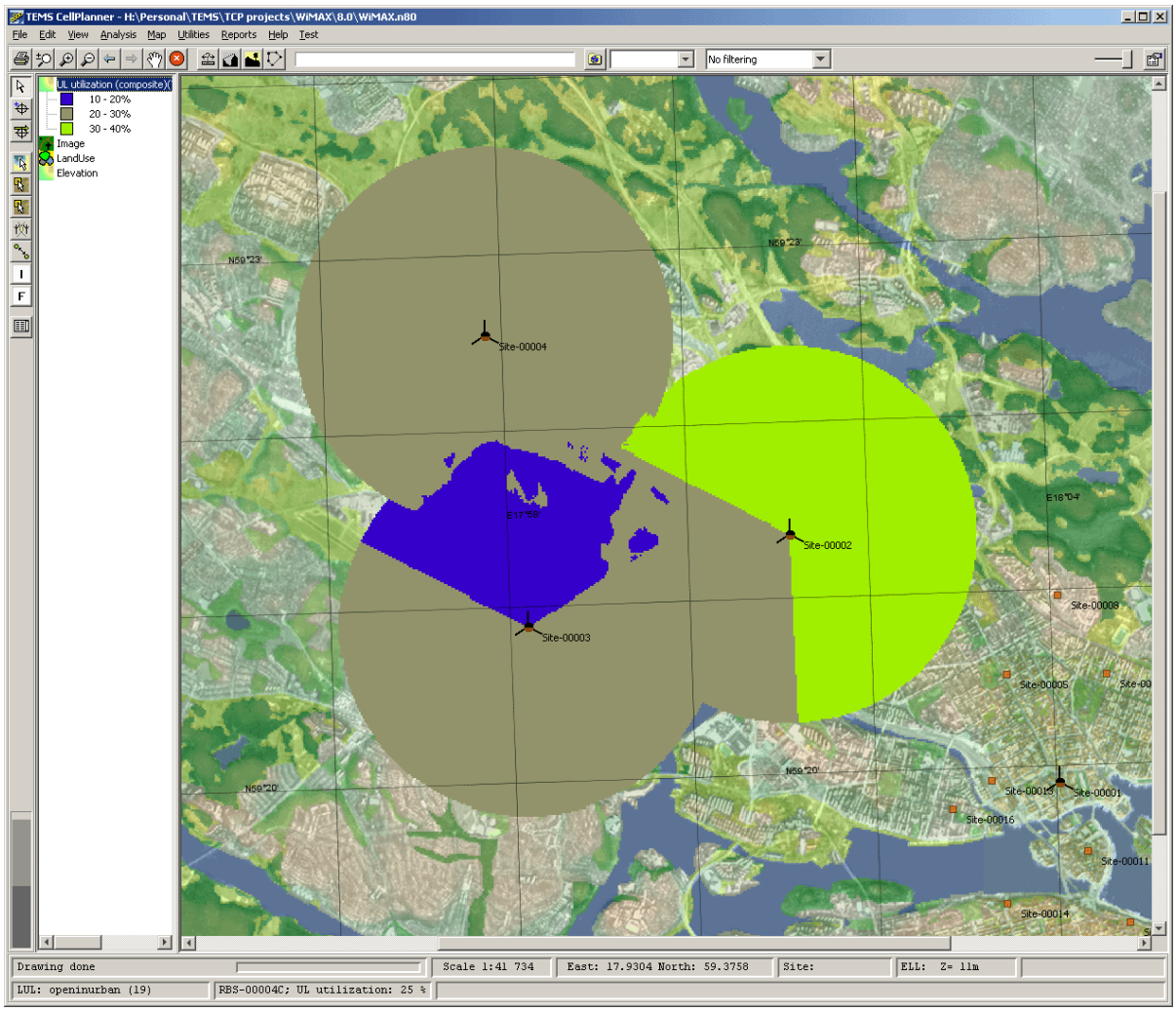
UL Utilization (Composite)

This plot displays the used percentage of the uplink capacity of the serving cell when the best MCS is used.

100% utilization of a cell's downlink capacity is reached when all downlink traffic sub-carriers are used all the time. Only pure traffic data is counted, signalling overhead is excluded.

The UL utilization is displayed on the status bar, together with the identity of the serving cell.

The figure below shows an example of an UL utilization plot (composite):



16
WiMAX Reports

This chapter describes the reports available from analysis of a WiMAX network plan, and how to generate them.

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WiMAX Fixed Subscriber Report 16-3
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Example of WiMAX Fixed Subscriber Report 16-5
WiMAX Traffic Analysis Report 16-6
Generate WiMAX Traffic Analysis Report 16-6
Format of WiMAX Traffic Analysis Report 16-6
Example of WiMAX Traffic Analysis Report 16-8

About WiMAX Reports

A *report* is a textual result from the analysis of a network plan.

The following reports are relevant for a WiMAX network:

- WiMAX fixed subscriber report
- WiMAX traffic analysis report

The reports marked with bold in the list above, are described in this manual. The reports common for WiMAX and other technologies are described in the *TEMS CellPlanner Common Features User's Guide*.

WiMAX Fixed Subscriber Report

The analysis of WiMAX fixed subscribers result in a report.

Generate WiMAX Fixed Subscriber Report

Use this procedure to generate and view a **WiMAX fixed subscriber report**.

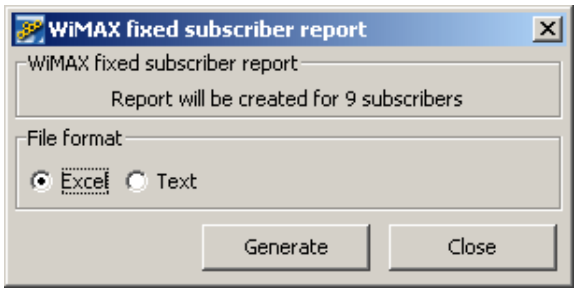
Prerequisites

Results from WiMAX Fixed Subscriber Analysis on page 14-10 are available.

Procedure

Follow these steps to generate the WiMAX fixed subscriber report:

1. Select **Reports↗WiMAX↗Fixed subscriber...** The **WiMAX fixed subscriber report** dialog is displayed:



2. Select the file format for the report.
3. Click **Generate** to create the report. The generated report is opened in the selected format. See Format of WiMAX Fixed Subscriber Report and Example of WiMAX Fixed Subscriber Report for more information.
4. Save the file.

Format of WiMAX Fixed Subscriber Report

The fixed subscriber report includes the following parts:

- a report header, with statistics for all fixed subscribers
- a report body, with one row per fixed subscriber site

Report Header

The report header includes the following information:

- Average signal strength (dBm)
- Average C/N (dB)
- Average DL data rate (kbps)
- Average UL deteriorate (kbps)
- Average power margin (dB)
- Percentage of connected users (%)

Report Body

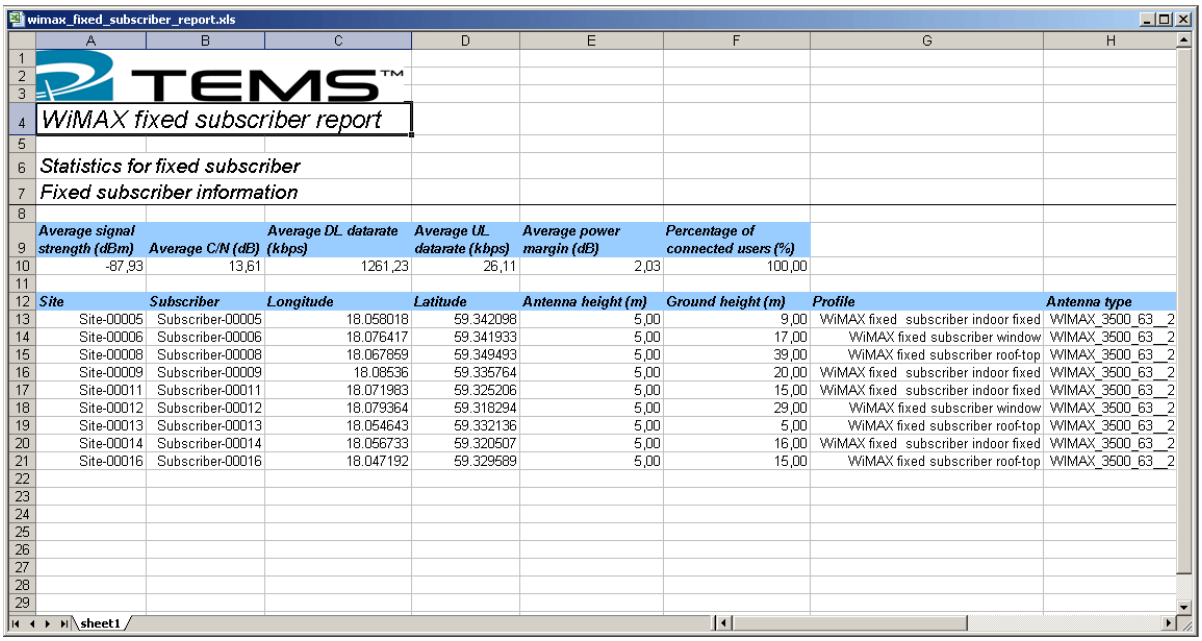
The report body includes the following information:

- Fixed subscriber identification
  - Site - Name of the fixed subscriber site
  - Subscriber - Name of the fixed subscriber
  - Longitude and Latitude - Site position
  - Antenna height (m) - Height above ground level
  - Ground height (m)
  - Profile - Fixed subscriber profile
  - Antenna type
  - Terminal - The terminal type
  - Carrier
- Best server predictions without interference - empty if fixed subscriber excluded from analysis
  - Best server - Name of the best serving cell
  - Received signal strength (dBm) - of the best serving cell
  - C/N (dB) - of the best serving cell
  - DL MCS - Best DL MCS without interference
  - DL data rate (kbps) - for the full carrier bandwidth, without interference
  - Power margin (dB) - for UL coverage
  - UL MCS - Best UL MCS without interference
  - UL deteriorate (kbps) - for the terminal type, without interference
- 2nd best server predictions and so on, up to the limit Depth of best server list
  - 2nd BS - Name of the second best serving cell
  - 2nd BS RSS (dBm) - Received signal strength of the 2nd best server
- DL interference predictions, included if results from interference analysis of fixed subscribers are available

- Achieved C/(I+N) (dB)
- Worst co-channel interferer - if present
- DL MCS - Best DL MCS with interference
- DL data rate (kbps) - for the full carrier bandwidth, with interference

Example of WiMAX Fixed Subscriber Report

The figure below shows an example of a WiMAX fixed subscriber report:



wimax_fixed_subscriber_report.xls

TEMS™

WiMAX fixed subscriber report

Statistics for fixed subscriber

Fixed subscriber information

Average signal strength (dBm)	Average C/N (dB)	Average DL datarate (kbps)	Average UL datarate (kbps)	Average power margin (dB)	Percentage of connected users (%)
-87,93	13,61	1261,23	26,11	2,03	100,00

Site	Subscriber	Longitude	Latitude	Antenna height (m)	Ground height (m)	Profile	Antenna type
Site-00005	Subscriber-00005	18.058018	59.342098	5,00	9,00	WiMAX fixed subscriber indoor fixed	WIMAX_3500_63__2
Site-00006	Subscriber-00006	18.076417	59.341933	5,00	17,00	WiMAX fixed subscriber window	WIMAX_3500_63__2
Site-00008	Subscriber-00008	18.067859	59.349493	5,00	39,00	WiMAX fixed subscriber roof-top	WIMAX_3500_63__2
Site-00009	Subscriber-00009	18.08536	59.335764	5,00	20,00	WiMAX fixed subscriber indoor fixed	WIMAX_3500_63__2
Site-00011	Subscriber-00011	18.071983	59.325206	5,00	15,00	WiMAX fixed subscriber indoor fixed	WIMAX_3500_63__2
Site-00012	Subscriber-00012	18.079364	59.318294	5,00	29,00	WiMAX fixed subscriber window	WIMAX_3500_63__2
Site-00013	Subscriber-00013	18.054643	59.332136	5,00	5,00	WiMAX fixed subscriber roof-top	WIMAX_3500_63__2
Site-00014	Subscriber-00014	18.056733	59.320507	5,00	16,00	WiMAX fixed subscriber indoor fixed	WIMAX_3500_63__2
Site-00016	Subscriber-00016	18.047192	59.329589	5,00	15,00	WiMAX fixed subscriber roof-top	WIMAX_3500_63__2

sheet1

WiMAX Traffic Analysis Report

The analysis of the WiMAX traffic performance result in plots and a report. How to generate the report is described in this chapter. For more information on the plots, see WiMAX Traffic Performance Plots on page 15-18.

Generate WiMAX Traffic Analysis Report

Use this procedure to generate and view a **WiMAX traffic analysis report**.

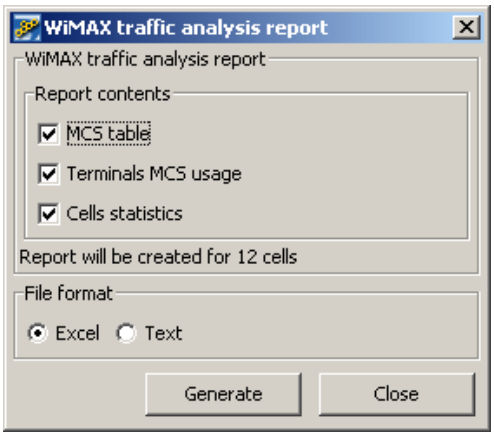
Prerequisites

Results from WiMAX Traffic Performance Analysis on page 14-14 are available.

Procedure

Follow these steps to generate a WiMAX traffic performance report:

1. Select **Reports↗WiMAX↗Traffic analysis...** The **WiMAX traffic analysis report** dialog is displayed:



2. Select the contents you want included in the report.
3. Select the file format for the report.
4. Click **Generate** to create the report. The generated report is opened in the selected format. See Format of WiMAX Traffic Analysis Report and Example of WiMAX Traffic Analysis Report for more information.
5. Save the file.

Format of WiMAX Traffic Analysis Report

The traffic performance report includes the following parts:

- MCS table
- Terminal table
- Cell statistics

The **MCS table** lists all available MCSs, one MCS per row, with the following information per row:

- MCS - Name of the modulation and coding scheme
- Bit rate (kbps)
- SS threshold (dBm) - Received signal strength required for each MCS
- C/(I+N) threshold (dB) - C/(I+N) ratio required for each MCS

The **terminal table** lists the MCS usage of all terminals:

- Downlink MCS usage
  - All used downlink MCSs, one MCS name per row
- Uplink MCS usage
  - All used uplink MCSs, one MCS name per row

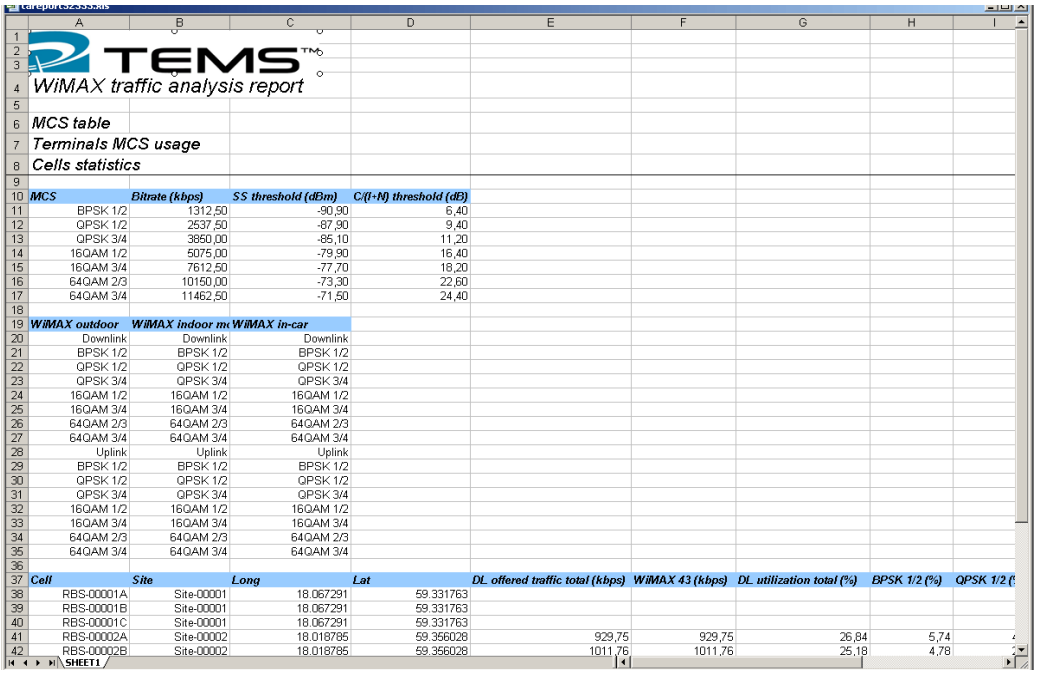
The **cell statistics** includes the following information, one row per cell:

- Cell - Name of the cell
- Site - Name of the site
- Longitude and Latitude - Site position
- DL offered traffic total (kbps)
- DL offered traffic per bearer (kbps), one column per bearer
- DL utilization total (%)
- DL utilization per MCS (%), one column per MCS
- UL offered traffic total (kbps)
- UL offered traffic per bearer (kbps), one column per bearer
- UL utilization total (%)
- UL utilization per MCS (%), one column per MCS

The traffic performance reported for each cell is the sum over the selected traffic cases for the carrier of cell.

Example of WiMAX Traffic Analysis Report

The figure below shows an example of a WiMAX traffic analysis report:



WiMAX traffic analysis report

MCS table

Terminals MCS usage

Cells statistics

MCS	Bitrate (kbps)	SS threshold (dBm)	C/(I+N) threshold (dB)
BPSK 1/2	1312,50	-90,90	6,40
QPSK 1/2	2537,50	-87,90	9,40
QPSK 3/4	3850,00	-85,10	11,20
16QAM 1/2	5075,00	-79,90	16,40
16QAM 3/4	7612,50	-77,70	18,20
64QAM 2/3	10150,00	-73,30	22,60
64QAM 3/4	11462,50	-71,50	24,40

WiMAX outdoor	WiMAX indoor m	WiMAX in-car
Downlink	Downlink	Downlink
BPSK 1/2	BPSK 1/2	BPSK 1/2
QPSK 1/2	QPSK 1/2	QPSK 1/2
QPSK 3/4	QPSK 3/4	QPSK 3/4
16QAM 1/2	16QAM 1/2	16QAM 1/2
16QAM 3/4	16QAM 3/4	16QAM 3/4
64QAM 2/3	64QAM 2/3	64QAM 2/3
64QAM 3/4	64QAM 3/4	64QAM 3/4
Uplink	Uplink	Uplink
BPSK 1/2	BPSK 1/2	BPSK 1/2
QPSK 1/2	QPSK 1/2	QPSK 1/2
QPSK 3/4	QPSK 3/4	QPSK 3/4
16QAM 1/2	16QAM 1/2	16QAM 1/2
16QAM 3/4	16QAM 3/4	16QAM 3/4
64QAM 2/3	64QAM 2/3	64QAM 2/3
64QAM 3/4	64QAM 3/4	64QAM 3/4

Cell	Site	Long	Lat	DL offered traffic total (kbps)	WiMAX 43 (kbps)	DL utilization total (%)	BPSK 1/2 (%)	QPSK 1/2 (%
RBS-00001A	Site-00001	18.067291	59.331763					
RBS-00001B	Site-00001	18.067291	59.331763					
RBS-00001C	Site-00001	18.067291	59.331763					
RBS-00002A	Site-00002	18.018785	59.356028	929,75	929,75	26,84	5,74	
RBS-00002B	Site-00002	18.018785	59.356028	1011,76	1011,76	25,18	4,78	

17
Maps and GeoData

A network plan is based on radio network data and map related information, GeoData.

As a radio network designer you need a basic knowledge about GeoData and how to use it in TEMS CellPlanner.

As a map administrator you need a deeper knowledge about GeoData, how to convert maps and perform other advanced GeoData related operations in TEMS CellPlanner.

Read more about GeoData in the *TEMS CellPlanner GeoData User's Guide*.

18 Puncturing

You can improve the accuracy of the pathloss predictions by using measured values of received power in selected parts of the WiMAX network plan.

This feature describes how to read measurement data from TEMS Investigation, TEMS Automatic and TEMS Pocket, and how to save the imported measurements as pathloss data files for later use in pathloss calculations.

Read more in *Using Puncturing* in the *TEMS CellPlanner Common Features User's Guide*

The recommended feature for integration of measurement data for pathloss calculations is Automatic Measurement Integration (AMI), described in the *TEMS CellPlanner Common Features User's Guide*.

19
Script Console

The script utility enables a TEMS CellPlanner user to perform complex customized operations from the **Utilities** menu.

The script support is based on Jython, a variant of Python supporting Java. Before using the script console, you must learn the basics of Python.

Scripts can access and modify a network configuration loaded into the client. Most dialogs in the tool can also be controlled by scripts. Scripts can be executed automatically at startup of a client.

Examples of script usage:

- Conditional modification of attributes
- Advanced search
- Specialized reports
- Specialized imports
- Sophisticated object renaming operations

Read more in **Help↗Manuals↗Script Support.**

20
WiMAX Glossary

The terms used when planning a WiMAX network are described in the *Glossary* of the *TEMS CellPlanner Common Features User's Guide*.

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